Construction Methods

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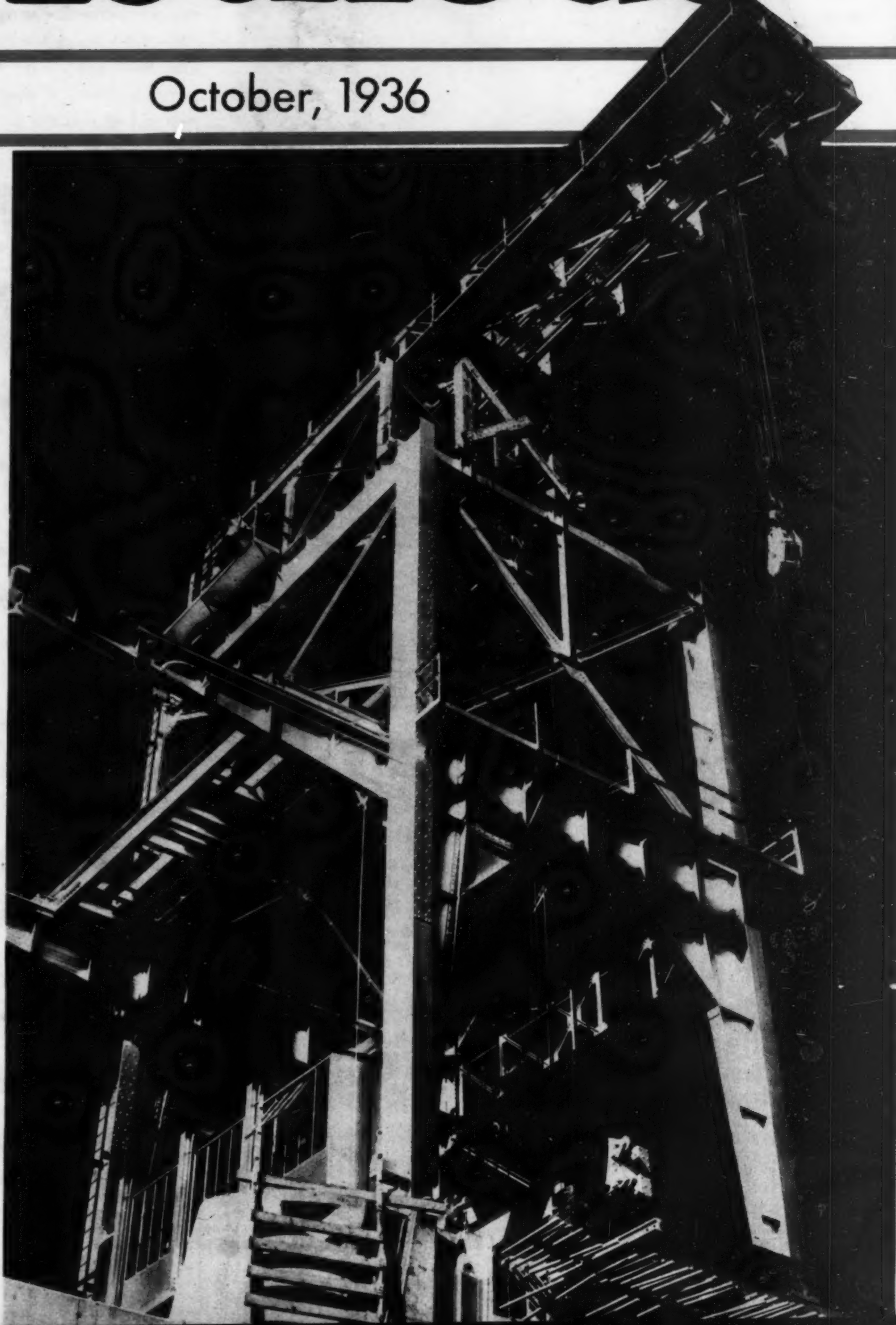
In This Issue:



STEEL AGAINST SKY: Traveling gantry crane for handling stop logs and trash racks is installed as part of permanent operating equipment at power-house intake of Bonneville power and navigation dam on Columbia River in Washington, being constructed under supervision of Corps of Engineers, U. S. Army, with initial allocation of $32,200,000 from Public Works Administration.

A quarter of a century of continuous service is an exacting test for any road. Yet such records are not unusual with Tarvia. Many highway officials can tell you of long-lived Tarvia roads like South McNeill Street, Memphis, which was Tarvia-built in 1911. Experience has shown that Tarvia roads are easy and inexpensive to build and require only the most economical maintenance to keep them smooth, easy-riding and skid-safe. The Tarvia field man is at your service. Phone, wire or write our nearest office.

THE TECHNICAL SERVICE BUREAU of The Barrett Company invites your consultation with its technically trained staff, without cost or obligation. Address The Technical Service Bureau, The Barrett Company, 40 Rector Street, New York.

South McNeill Street, Memphis, Tennessee. Tarvia-built in 1911, the year of the first transcontinental aeroplane flight—flying time, 84 hours, 2 minutes!

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Current Jobs

AND WHO'S DOING THEM

Buildings

Industrial—A $5,570,000 contract for buildings to form a new plant for General Motors Corp. at Linden, N. J., was awarded to **J. A. Utley Co.**, of Detroit, Mich. Plant improvements for the Tubize Chattillon Corp. at Rome, Ga., have been placed with **Robert & Co.**, architects and engineers, of Atlanta, for $2,800,000. For a $2,000,000 seven-story furniture exchange building for the Capital Co., of San Francisco, Calif., successful bidders were **Cahill Bros.**, San Francisco (for building construction), and **Sibley Grading & Teaming Co.**, San Francisco, for grading site. At Battle Creek, Mich., **H. K. Ferguson Co.**, of Cleveland, will build for the General Foods Co. reinforced concrete factory buildings costing $1,500,000. Shell Petroleum Co., at Houston, Tex., has engaged **Arthur G. McKee**, of Cleveland, to build a new crude oil and cracking plant for $1,500,000. A rack house for Hiram Walker & Sons Co., at Peoria, Ill., is under construction by **Gamble Construction Co.**, of St. Louis, Mo., for $900,000.

Public—Several more superstructure contracts for mass housing have been let by the Housing Division of the Public Works Administration; they include the following: Westfield Acres project, in Camden, N. J., to **A. P. Miller, Inc.**, of Atlantic City, N. J., for $2,488,500; Julia Lathrop Homes, in Chicago, Ill., to **H. Ericson**, of Chicago, for $2,097,000 (north section) and to **United States Fireproofing Co.**, of Chicago, for $2,284,600 (south section); Hill Creek project, in Philadelphia, Pa., to **Turner Construction Co.**, of Philadelphia, for $1,521,440; New Towne Court project, in Boston, to **John Bowen Co.**, of Boston, for $1,139,300; Fairfield Court project, in Stamford, Conn., to **C. J. Maney Co., Inc.**, and **New England Foundation Co.**, both of Boston, for $690,956; College Court project in Louisville, Ky., to **Coath & Goss**, of Nashville, Tenn., for $551,532.

Among recent larger awards for Federal buildings are: U. S. post office at Cincinnati, Ohio, to **Great Lakes Construction Co.**, of Chicago, for $2,876,792; post office and court house at Indianapolis to **Great Lakes Construction Co.**, of Chicago, for $1,522,451; veterans' hospital at Northport, N. Y., to **White Construction Co.**, of New York City, for $1,342,000; police court building in Washington, D. C., to **Consolidated Engineering Co.**, of Baltimore, for $1,312,312; jail at San Pedro, Calif., to **Robert E. McKee**, of Los Angeles, for $879,000.

For a steam turbine generating plant in Ogden, Utah, contract has been awarded to **A. C. Dodd**, contractor of Salt Lake City, Utah, for $2,490,000. New York State hospital buildings at Orangeburg, N. Y., went to **Turner Construction Co.**, of New York City, for $2,200,000. With its own forces International Business Machines Corp. is building at Union, N. Y., a group of 350 employee residences to cost $2,000,000. Kansas City, Mo., let a $1,270,892 contract for a new 32-story city hall to **Swenson Construction Co.**, of Kansas City.

Commercial—Civic center, to include 25 buildings, at Princeton, N. J., will cost $4,500,000; contract for $350,000 tavern was bid in by **Matthews Construction Co.**, of Princeton. **Keystone Development Home Building Co.**, of Pittsburgh, has started work on the first twelve of a total of 400 brick houses in Weir'on, W. Va., to cost $1,800,000. The **Chanin Organization**, of New York City, is at work on the first unit of 25 dwellings to be erected at Hempstead, N. Y., at a cost of $1,000,000.

Highways—Some of the recent highway contract awards include the following: New Jersey, $387,196 to **A. Bambermade-Tidewater Stone & Supply Co.**, of Hackensack, for 4.46 mi. of reinforced-concrete paving near Hightstown. New York, $371,407 to **Tomack Subsidiary Inc.**, of Rochester, for 17.35 mi. in Cattaraugus County; $329,586 to **Immick Co., Inc.**, of Meriden, Conn., for 1.51 mi. in Bronx County; $274,862 to **F. Stento**, of Binghamton, for 4.49 mi. in Cortland County; $264,821 to **Belmar Contracting Co.**, of Troy, for road in Franklin County. Mississippi, $357,350 to **West Construction Co.**, Chattanooga, Tenn., for 15.2 mi. in Winston County; $327,957 to **J. P. McNulty**, of Pine Bluff, Ark., for 12.2 mi. in Sharkey County; $280,933 to **R. Myers**, of Campbellsburg, Ind., for 15.5 mi. in Clarke county; $247,365 to **Forcum-James Construction Co.**, of Dyersburg, Tenn., for 8.35 mi. in Sharkey County. Idaho, $354,219 to **J. C. Compton**, of McMinnville, Ore., and **Hoops Construction Co.**, of Twin Falls, Idaho, for 4.24 mi. near Twin Falls. Ohio, $346,992 to **Cleveland Trinidad Paving Co.**, of Cleveland, for 3.7 mil. of brick paving in Lake County. Pennsylvania, $300,018 to **H. R. Miller Co.**, of Lancaster, for 3.39 mi. of dual-type (cement concrete and bituminous) in Delaware County. Washington, $298,049 to **J. Warter** of Tacoma, for 7.1 mi. of concrete paving, Olympia - Nisqually. Iowa, $293,493 to **Booth & Olson, Inc.**, of Sioux City, for 11.4 mi. in Pocahontas County. Maryland, $271,458 to **V. Schiavi**, of Washington, Del., for 4.08 of concrete paving.

Bridges—For a bridge on Woodville-Natchez highway in Mississippi, **F. V. Ragsdale Co.**, of Memphis, received a $732,921 contract. **Penker Construction Co.**, of Cincinnati, Ohio, bid $660,209 and $662,123 on two contracts of the Columbia Ave. viaduct in that city. To **Corbetta Construction Co.**, of New York City, went a $530,730 project for low level bridge over Little Hell Gate, East River. Underpass structure in Hennepin County, Minnesota, has bid in for $281,942 by **Fielding & Shepley**, of St. Paul. In Vancouver, B. C., the $2,000,000 substructure contract for the First Narrows bridge went to **Stuart Cameron & Co., Ltd.**, of Vancouver.

Waterways—At Bellevue, Ia., **Warner Construction Co.**, of Chicago, bid in Mississippi River Dam No. 12 for $2,224,158. At Sauerton, Mo., **Massman Construction Co.**, of Kansas City, Mo., obtained Mississippi River Dam No. 22 for $2,111,052. A $1,993,225 dredging contract on the New York State Barge Canal was obtained by **Great Lakes Dredge & Dock Co.**, of Buffalo. Another dredging contract on the St. Johns River, in Florida, went to the **Atlantic, Gulf & Pacific Co.**, of New York, for $1,153,730. In Texas the Lower Colorado River Authority awarded a $783,773 contract for Roy Inks dam to **Morrison - Knudsen Co.**, of Boise, Idaho.

Waterworks—**Walsh Construction Co.**, of Indianapolis, Ind., obtained for $1,685,231 the 180-ft. concrete dam for the new industrial water supply at Birmingham, Ala. For the Hayfield pumping plant on the Colorado River Aqueduct in California, the bid of $1,330,765 by **L. E. Dixon & Case Construction Co.**, of Los Angeles, secured the contract. At Little Rock, Ark., earth dam went to **L. O. Brayton**, of Dyersburg, Tenn., for $921,726. For precast concrete pipe on upper feeder system of the Colorado River Aqueduct **United Concrete Corp.**, of Los Angeles, was successful bidder with $955,371.

Subway—A $6,392,879 contract for a section of the Sixth Ave. subway, in New York City, was awarded to **Carleton Co., Inc.**, of New York.

Construction Methods

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ROBERT K. TOMLIN, Editor — **OCTOBER, 1936** — WILLARD CHEVALIER, Vice-President

Editorial Staff: Vincent B. Smith, John B. Huttl (San Francisco)
Nelle Fitzgerald

How—

... For the benefit of readers concerned with the practical application of method or equipment the following references are to articles or illustrations in this issue that tell:

CONSTRUCTION—

A Mobile Industry

LAST MONTH this page pointed out that even in this day of mass production and management, construction remains a made-to-order industry. But this is not the only respect in which construction differs from other industries.

Another is its mobility. Most other industries are carried on in plants located at fixed sites. But, from its nature, construction must be prosecuted at the site of the structure. The constructor must take his plant and his staff to his work rather than have his work brought to them.

At any given time the construction under way will consist of many jobs—a few of them very large but the vast bulk much smaller. Three months or six months hence an equal volume may include a few of the same jobs and a lot of new ones. The big jobs may still be under way but many of the smaller ones will have been finished and replaced by new ones. Meanwhile many constructors will have dismantled their plant on the completed work and moved to the new jobs. The production units of the industry will have been reshuffled to suit the distribution of the new work.

This means that the construction industry, like any other field force, must be mobile. To be sure, constructors who are carrying on a number of jobs may maintain central offices at some convenient point to carry on their "paper work" and other overhead activities. But the producing end of their business is in the field at the site of the work, and that must be kept mobile.

ALL THIS is reflected not only in the technique of construction practice, as suggested last month, but also in the types of construction equipment and in the constructor's attitude toward his plant account.

Now and then some very large undertaking that may be in process for several years will justify a substantial installation of standard industrial equipment. But that is exceptional; for the most part, construction plant must be composed of relatively small equipment units, each self-contained, compact, not too heavy, convenient for shipping and readily adaptable to new combinations on a variety of work. Usually the higher operating economy of the stationary plant must be sacrificed to such mobility and versatility.

Because he must take down and ship his plant at the end of each job, the constructor is likely to have a very liberal attitude toward obsolescence. He is more inclined than are other industrialists to figure a short life for his plant, to drive it to capacity and to write it off more quickly. This accounts in part for the extra ordinary development of construction plant and technique during the last two decades; the constructor is not given to over-capitalizing his plant and to holding back his efficiency to that of outmoded equipment. The need for planting each job anew is a modernizing influence that stimulates improvement and holds the doors of the industry open to new products and ideas.

THIS MOBILITY affects also the practice of merchandising to the industry. Much of the buying influence has no fixed abode but moves about with the work. Again, headquarters may be fixed, but in an industry with so close a relationship between plant and performance on each individual job, the man in the field is an important factor; and he moves about with the job. Evidence of this is the fact that journals such as *Construction Methods* and its companion *Engineering News-Record* are required by their readers to enter changes of address every year amounting to nearly forty per cent of their subscription lists, in order that their papers may follow them wherever they go. Those who would sell to the construction industry must hold their beads on moving targets.

In short, every effort to deal with the industry—to organize it, to regulate it, to do business in it or with it, or even to understand it—must recognize this distinctive mobility; which gives rise to problems and viewpoints quite different from those of the fixed industries.

Willard Chevalier

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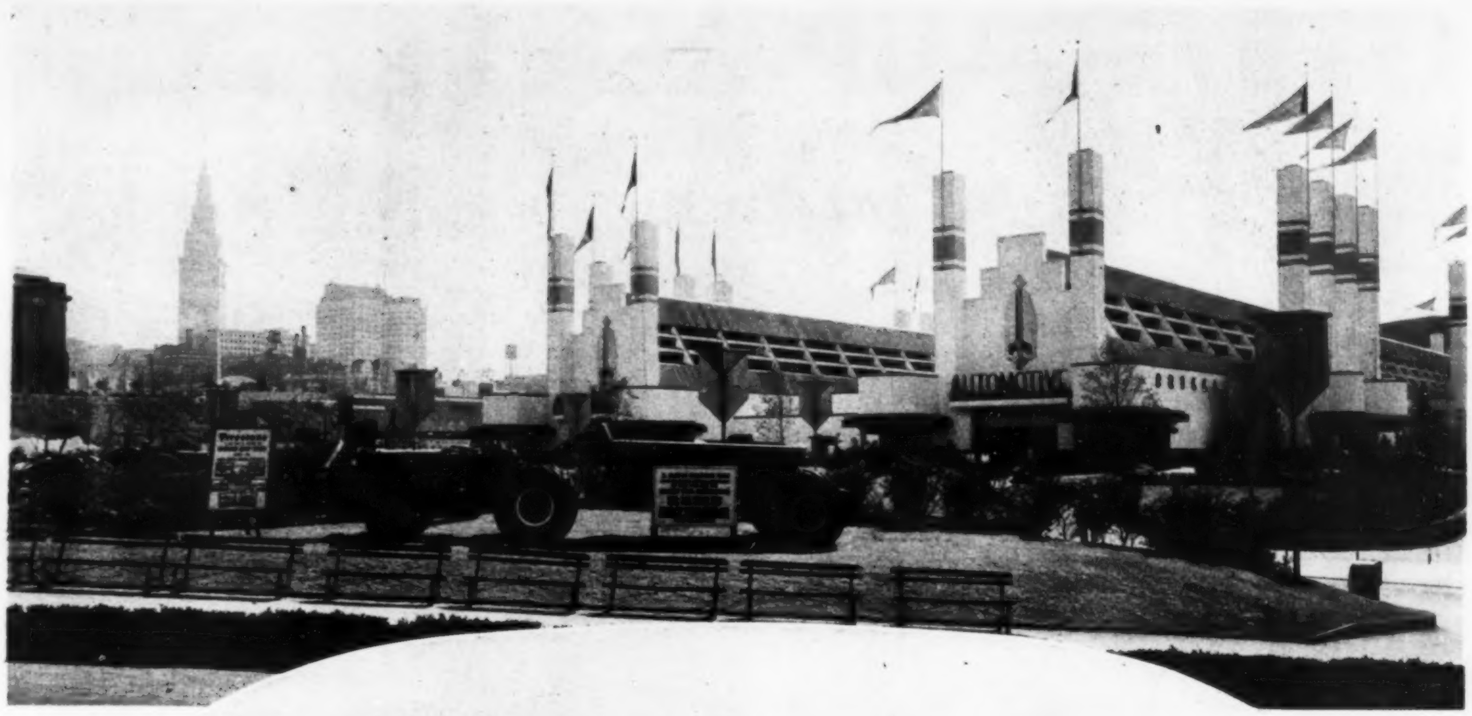

TRAC-TRUK *featured*

at GREAT LAKES EXPOSITION

REPRESENTING FOREMOST DEVELOPMENT IN MODERN DIRT MOVING EQUIPMENT

The theme of this great Exposition—of international scope and interest—was to depict progress through the various cycles of change, coincident with events and displays representative of present day developments—including the latest and best of all inventive minds. That this huge presentation was considered of extreme interest and importance was evidenced by the admission of near 4,000,000 visitors. Of distinctive merit and notable significance was the selection of a Trac-Truk—occupying the center position on the Exhibit grounds—as exemplifying the foremost development in material handling and hauling equipment.

EUCLID THE PIONEER

THE EUCLID ROAD MACHINERY CO.
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G-E EQUIPMENT

plays a major part in speeding work at

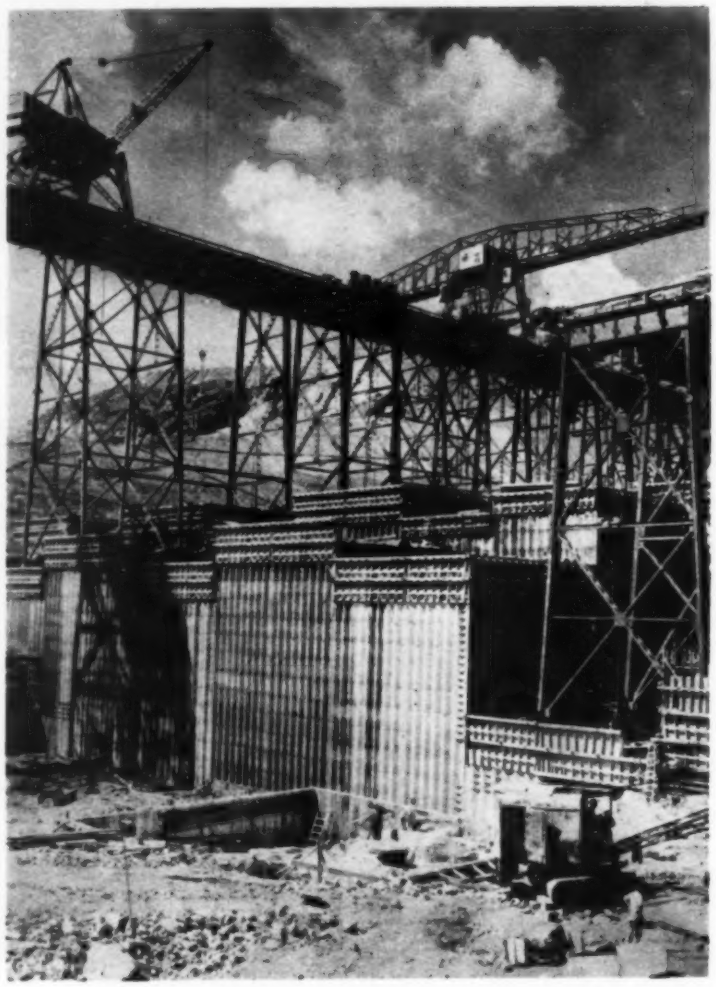
GRAND COULEE DAM

ON THIS tremendous project the contractors employ modern and special machines, together with numerous new machines of *standard* type which have proved their worth on jobs where time is money. Here was constructed the world's longest conveyor system, operated by G-E motors and control, and the latest design in a gigantic concrete-batching plant. In the latter, G-E motors and control play an important part in the automatic, amazing output of 7,000 cubic yards of precisely mixed concrete per day into the rapidly growing west base of the dam.

Huge electric whirley cranes equipped with G-E motors and automatic G-E control lower concrete from trestle to forms. To clear a bedrock base for the concrete, G-E equipped electric shovels dug and loaded more than twice the amount of material that was excavated at Boulder Dam.

The main transformers and distribution and protective equipment, which feed energy to the project, are General Electric — built and tested in the G-E plant where artificial lightning in bolts of several million volts is created for study.

Throughout the project, electric equipment — new, modern, cost-saving, always available, convenient, accurate, and safe — has written a record large in the annals of this mighty project.



One of four Koehring mixers driven by G-E motors in .Westmix concrete plant equipped with G-E motors, solenoids, and mercury switches for automatic operation

Synchronous motors of unity power-factor driving Ingersoll-Rand and Chicago Pneumatic air compressors

YOU GET SPEED FOR THE JOB, MORE SERVICE FOR YOUR MONEY, WHEN YOU BUY G-E EQUIPMENT

The Mason-Walsh-Atkinson-Kier Company, Grand Coulee Dam contractors, and the machinery manufacturers supplying equipment for construction, have had the co-operation of the General Electric field and factory organizations. The same time- and money-saving services are available to you. General Electric sales and service facilities are more conveniently located than those of any other electrical manufacturer. Get in touch with a G-E representative when you are planning your next construction job. General Electric, Schenectady, N. Y.

PARTIAL LIST OF G-E APPARATUS AT GRAND COULEE

Complete motor and control equipment for main dirt conveyor

Main power-transformer bank and substation equipment

Motors and control for all-electric, gas-electric, and diesel-electric shovels

Electric welders and electrodes

Magnetic switches for protection of motors and control

Watthour meters and current transformers for camp

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Motors and control for whirley cranes

Motors for pumps

Solenoid valves for air, water, and steam

Floodlighting projectors

GENERAL ELECTRIC

Dollars-and-Cents

OF COLD-WEATHER CONCRETING

LOW temperatures and long-standing habit usually bring winter construction almost to a standstill. This persistent tendency to "wait until Spring" means retarded recovery and reduced employment, precisely when it is needed most. Maybe cold-weather delays were necessary, when low temperatures meant extended freezing hazards, increased concreting costs and slowed construction progress. But the old picture has been radically changed by 'Incor', the improved Portland Cement which cures or hardens in one-fifth the usual time — with these significant results:

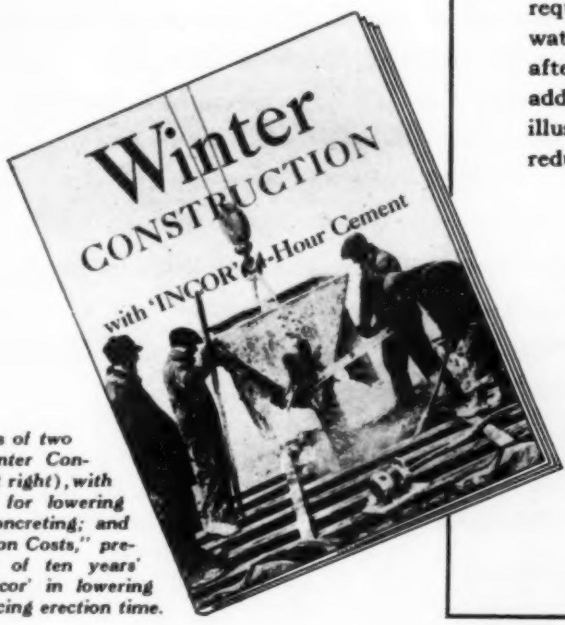
60 to 70 per cent saving

A 60 to 70 per cent reduction in the cost of heating and protecting concrete against low temperatures (see typical saving, below); faster re-use of forms—one set with 'Incor' does the work of two or three with ordinary cement; summer erection schedules in dead of winter; and steadier construction progress—which means that the time men used to waste idling around a fire is turned into wages.

These advantages, realized through 'Incor's dependable high early strength, make year-around building — talked about for a generation — a thoroughly practical reality.

Two illustrated books give full details. One, entitled "Winter Construction" (shown below), gives simple concreting precautions needed in cool, cold and sub-freezing weather; tells how 'Incor'* reduces costs, makes summer schedules possible in winter months. The other book, "Cutting Construction Costs," deals in a simple, practical way with the cost factors in concrete-frame erection, giving suggestions for concreting economies. For free copies, address Lone Star Cement Corporation (subsidiary of International Cement Corporation), Room 2203, 342 Madison Avenue, New York.

*Reg. U. S. Pat. Off.



Write for free copies of two timely books: "Winter Construction" (shown at right), with helpful suggestions for lowering cost of Winter concreting; and "Cutting Construction Costs," presenting the results of ten years' experience with 'Incor' in lowering form costs and reducing erection time.

TYPICAL WINTER SAVINGS WITH 'INCOR'

The quicker concrete hardens, the less time and expense are required to provide heat. With 'Incor', you simply heat mixing water and aggregates and provide heat-protection for 24 hours after concrete is placed. With ordinary cement, at least two additional days' heat-curing are necessary. Following example illustrates heat-protection savings—one of several ways 'Incor' reduces costs:

6-story concrete frame — 100'x100'
30 salamanders required to provide heat per floor.

Operating Costs:	
Coke, 5 tons a day, at $8	$40 per day
Labor, 4 men tending fires, at $5	20 per day
Heat Cost	$60 per day
'Incor' Saves:	
2 days' heating expense per floor	$120
For 6 stories and roof	840

These savings in fuel and labor are usually accompanied by substantial form savings and reduction in erection time, which means reduced overhead costs as well.

'INCOR' 24-HOUR CEMENT

For lower Winter maintenance costs

Call the TEXACO-TRAINED man...

FOR many years Texaco-Trained men have helped truck fleet operators reduce their lubrication and repair costs.

The Texaco-Trained man knows intimately the products he has to sell . . .

But more than that . . .

He knows the problems you have to face in winter lubrication. He can go out in your shops . . . examine your equipment . . . and recommend the exact grade of New Texaco Motor Oil, Texaco Marfak, and Thuban that will help you make further reductions in your operating costs this winter.

One of the results of this cooperation is evident in the fact that users of Texaco Lubricants and Fuels have won ten of the Bus Maintenance Awards during the past six years. The Texaco-Trained representative will be glad to provide practical engineering service to prove the economies of these products.

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KOEHRING DUMPTORS

—used by leading contractors, for all types of grading and hauling jobs. Proven performance, economical upkeep, increased production and low cost hauling—all outstanding features of this modern dirt-moving unit. Repeat orders to increase original fleets give definite proof of contractor acceptance.

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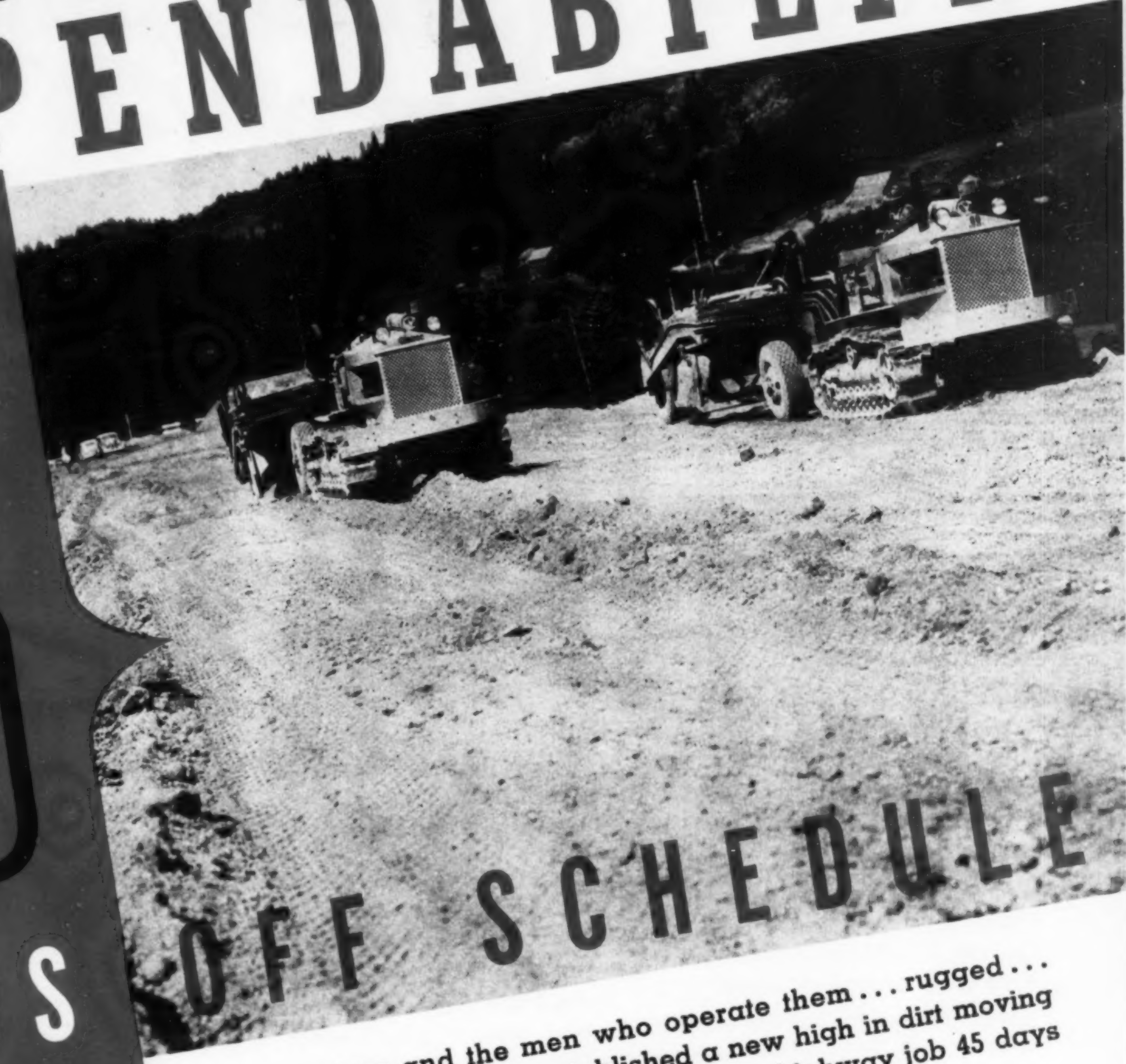
CLETRAC DEPENDABILITY



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Cletrac tractors and the men who operate them . . . rugged . . . dependable . . . enduring . . . established a new high in dirt moving economy when they completed an Oregon highway job 45 days ahead of schedule.

A Cletrac and bulldozer worked on the fills. Cletrac FD (Diesel) tractors worked three 7-hour shifts, six days per week, pulling 12-yard scrapers on a haul that averaged 1,100 feet long, and maintained an average of 12 trips per hour. This terrific pace was kept up for nearly 6,000 hours of operation.

A complete line of crawler tractors equipped with gasoline and Diesel engines.

Cletrac
Crawler Tractors
Built To Endure
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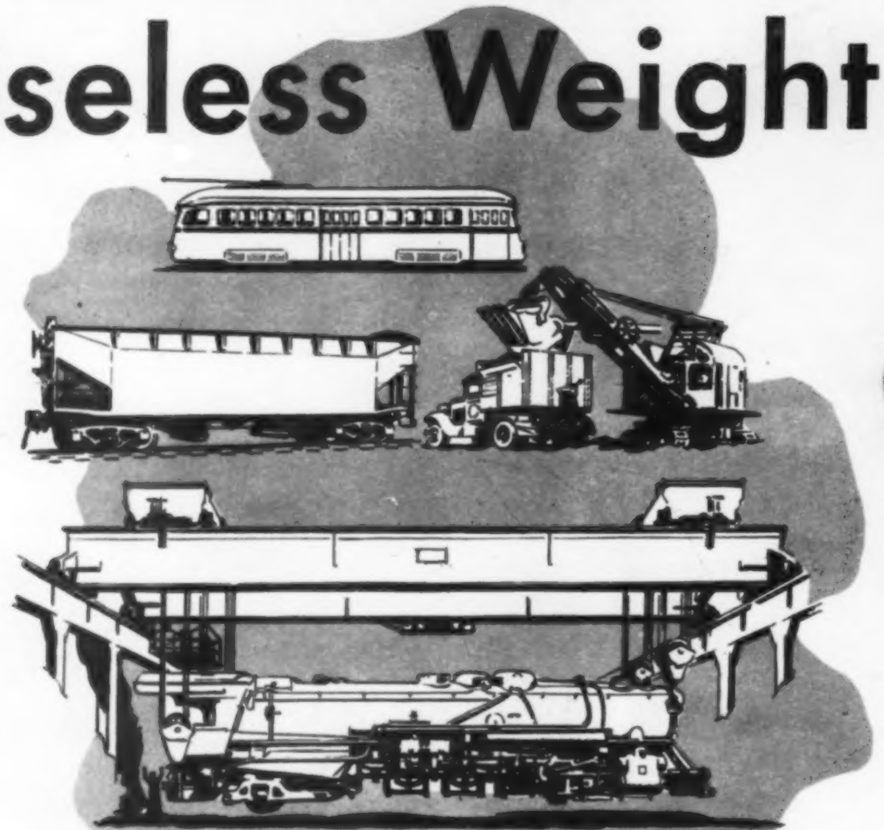
THE CLEVELAND TRACTOR COMPANY
CLEVELAND, OHIO

Inland Hi-Steel Solves Your Problem of Useless Weight



● Useless weight is costly. On equipment you use, power is wasted dragging around useless weight. On equipment you may build for sale, useless weight is fast becoming a sales handicap.

Inland Hi-Steel has a minimum tensile strength of from 70,000 to 75,000 lbs. p.s.i., and a minimum yield point of from 55,000 to 60,000 lbs. p.s.i., depending upon gage.

With Inland Hi-Steel . . . the new, high strength alloy . . . the weight of any piece of motive equipment can be reduced from 25% to 50% for Hi-Steel is twice as strong as carbon steel. The economies soon pay for Hi-Steel, for less material is required, and operating costs are reduced.

HIGH RESISTANCE TO CORROSION
Two of the principal alloys used in Hi-Steel are practically impervious to corrosion. Their alloying influence makes Inland Hi-Steel endure corrosion several times as long as carbon steel.

Inland Hi-Steel is readily welded, cut, formed, and otherwise fabricated. It has a high degree of uniformity. Made in structurals, bars, plates and sheets, all Inland Products where high strength and high corrosion-resistance are desirable.

Inland metallurgists will gladly discuss the possibilities of improving your products with Inland Hi-Steel. As a beginning write for Bulletin No. 10.

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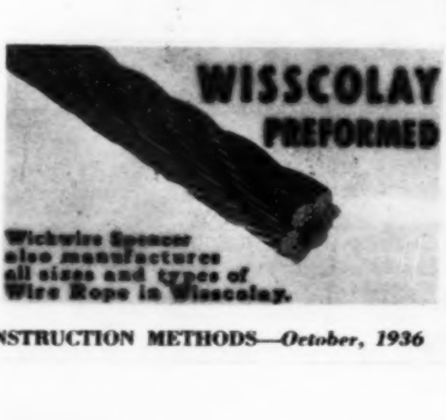
WIRE ROPE by Wickwire Spencer



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Please send me your new Rope Manual that tells how to make wire rope last longer.

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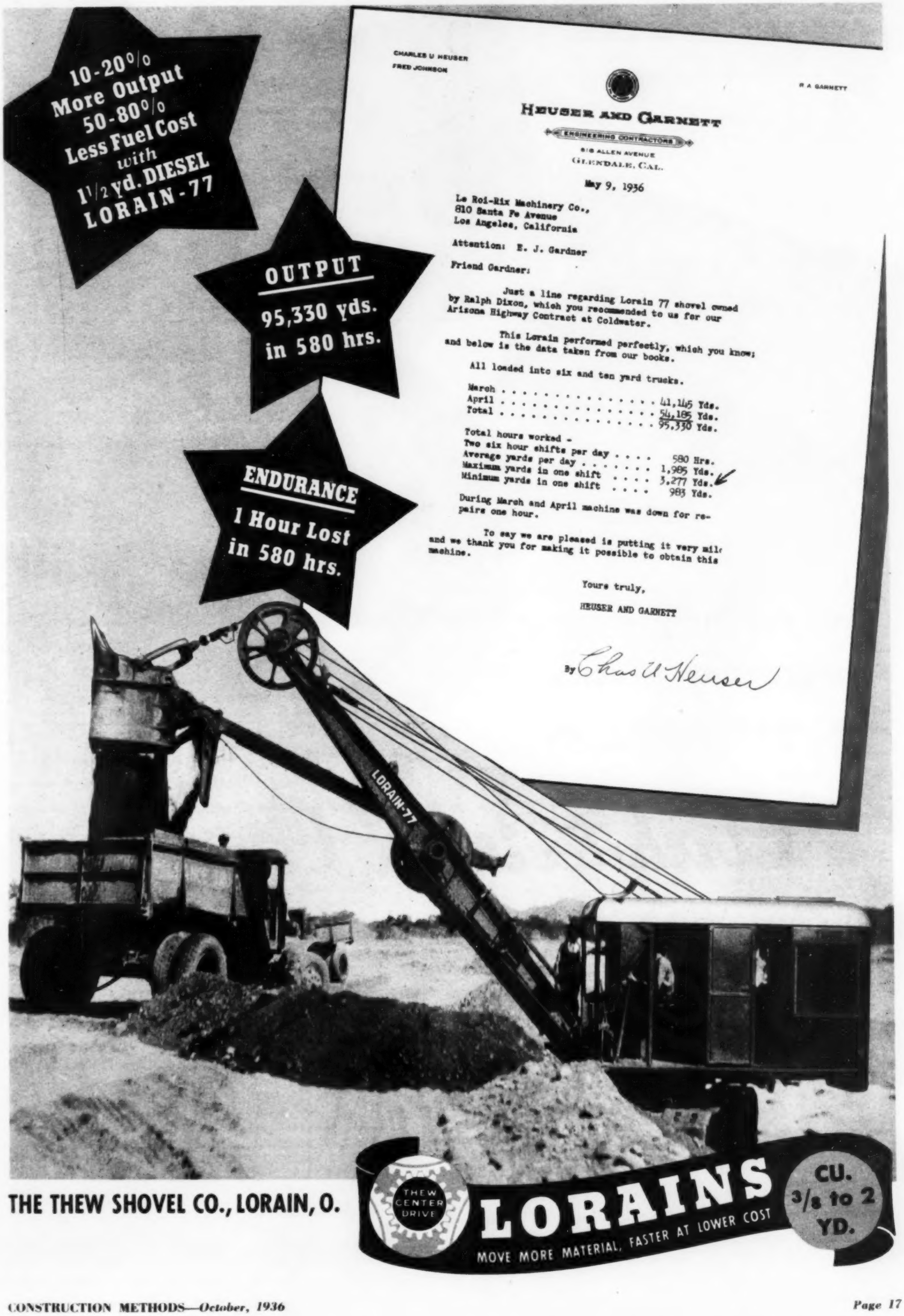
10-20%
More Output
50-80%
Less Fuel Cost
with
1½ yd. DIESEL
LORAIN-77
OUTPUT
95,330 yds.
in 580 hrs.
ENDURANCE
1 Hour Lost
in 580 hrs.
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GLENDALE, CAL.
May 9, 1936
Le Roi-Rix Machinery Co.,
810 Santa Fe Avenue
Los Angeles, California
Attention: E. J. Gardner
Friend Gardner:
Just a line regarding Lorain 77 shovel owned by Ralph Dixon, which you recommended to us for our Arizona Highway Contract at Coldwater.
This Lorain performed perfectly, which you know; and below is the data taken from our books.
All loaded into six and ten yard trucks.
March . . . .
April . . . . 41,145 Yds.
Total . . . . 54,185 Yds.
. . . . 95,330 Yds.
Total hours worked -
Two six hour shifts per day . . . . 580 Hrs.
Average yards per day . . . . 1,985 Yds.
Maximum yards in one shift . . . . 3,277 Yds.
Minimum yards in one shift . . . . 983 Yds.
During March and April machine was down for repairs one hour.
To say we are pleased is putting it very mil and we thank you for making it possible to obtain this machine.
Youre truly,
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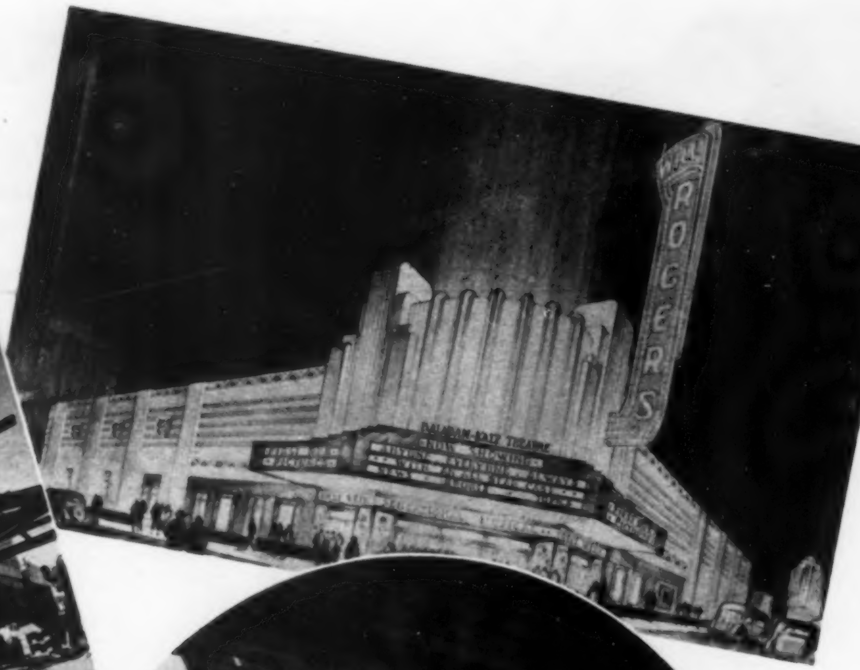
MOVE MORE MATERIAL, FASTER AT LOWER COST
CU. 3/8 to 2 YD.

Will Rogers Theatre, Chicago, Ill. Architectural concrete exterior. C. W. & Geo. L. Rapp, Inc., architects; Paschen Bros. Construction Co., contractors

Interior showing lightweight concrete masonry furred and left exposed



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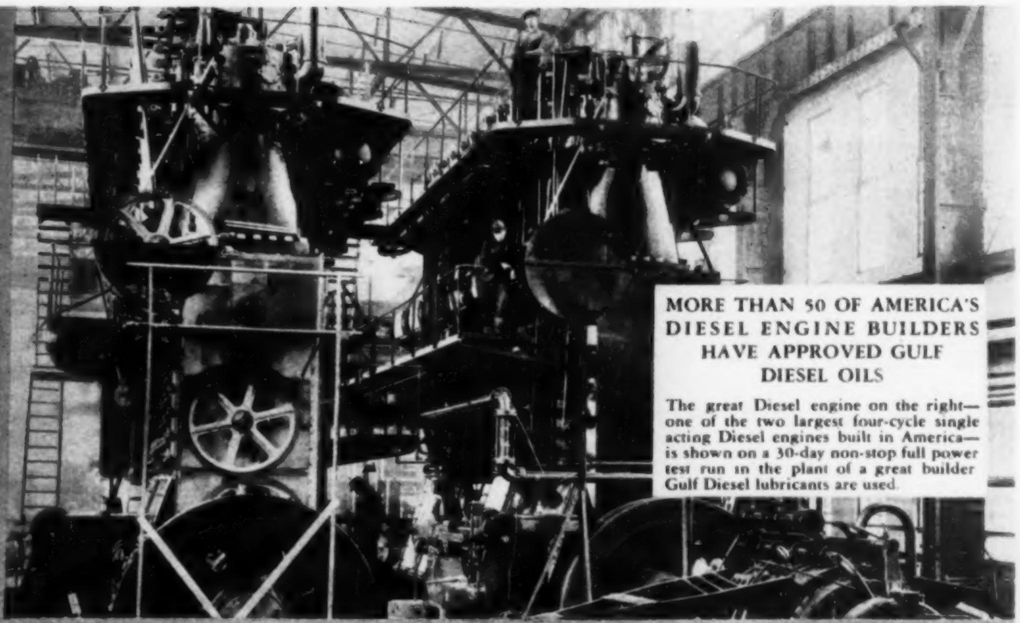

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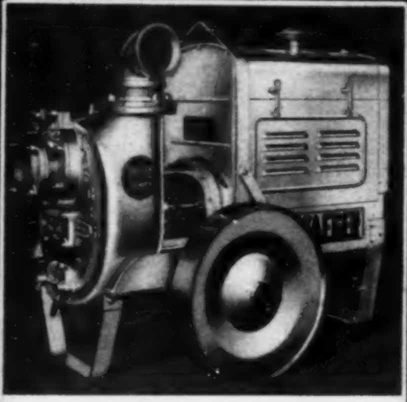

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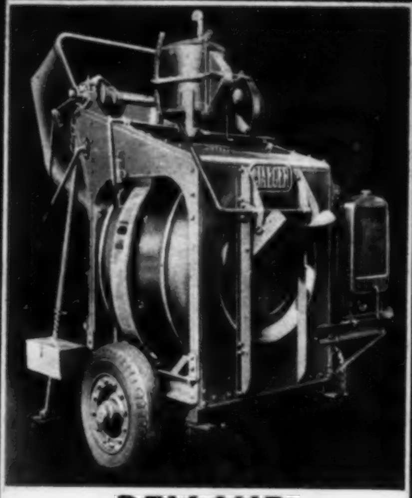

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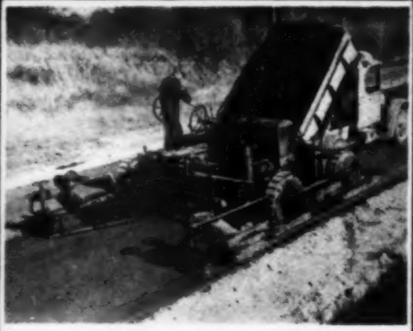

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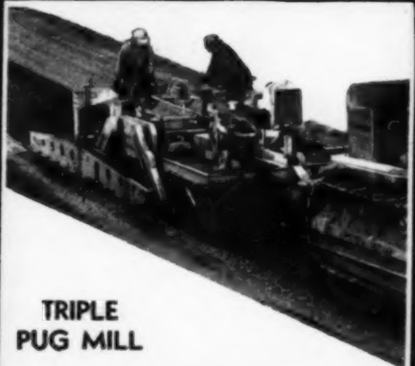

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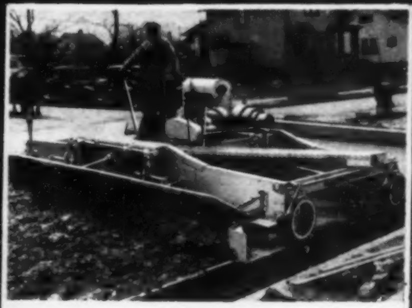

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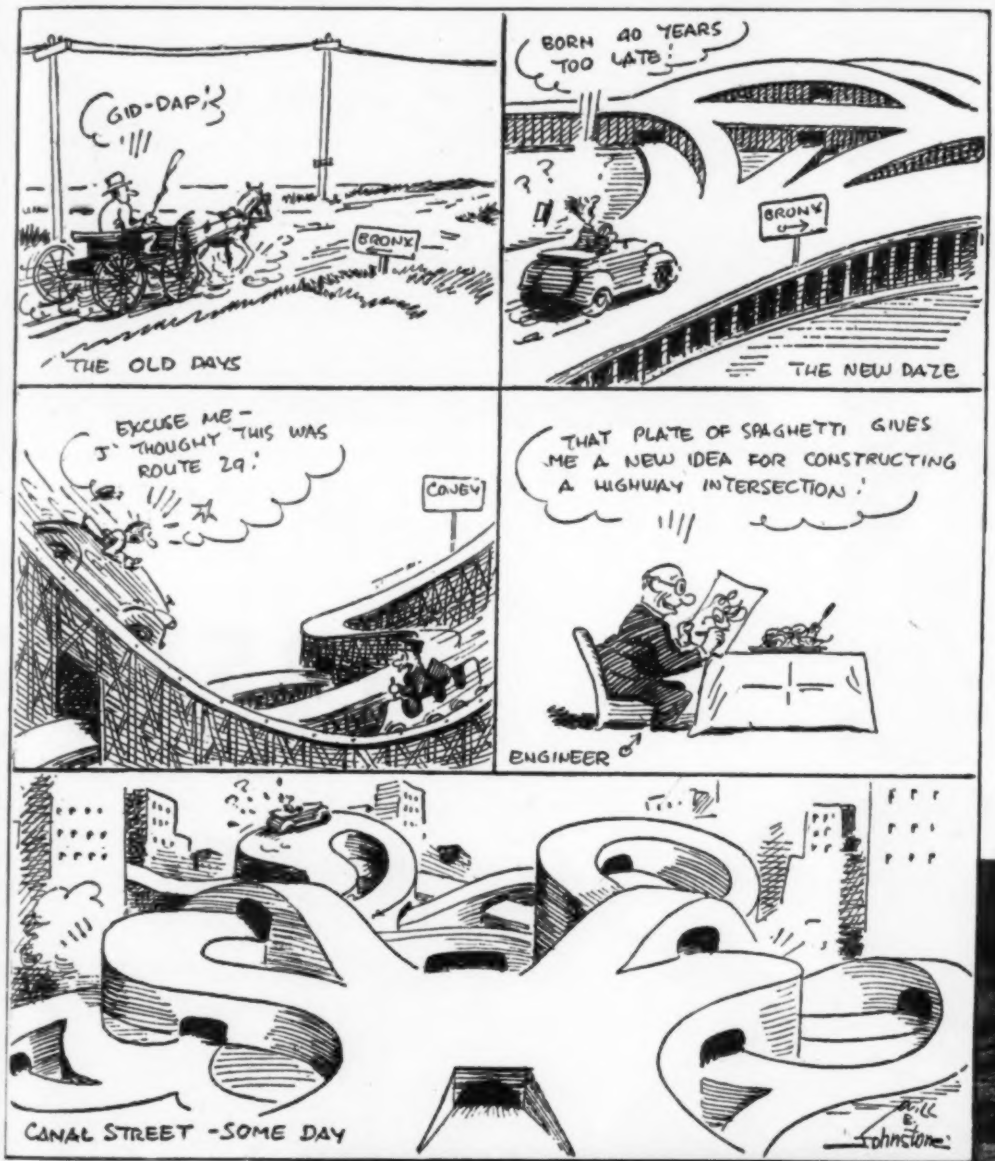
Construction Methods

ROBERT K. TOMLIN, Editor

Volume 18 **October, 1936** Number 10



Traffic Circle

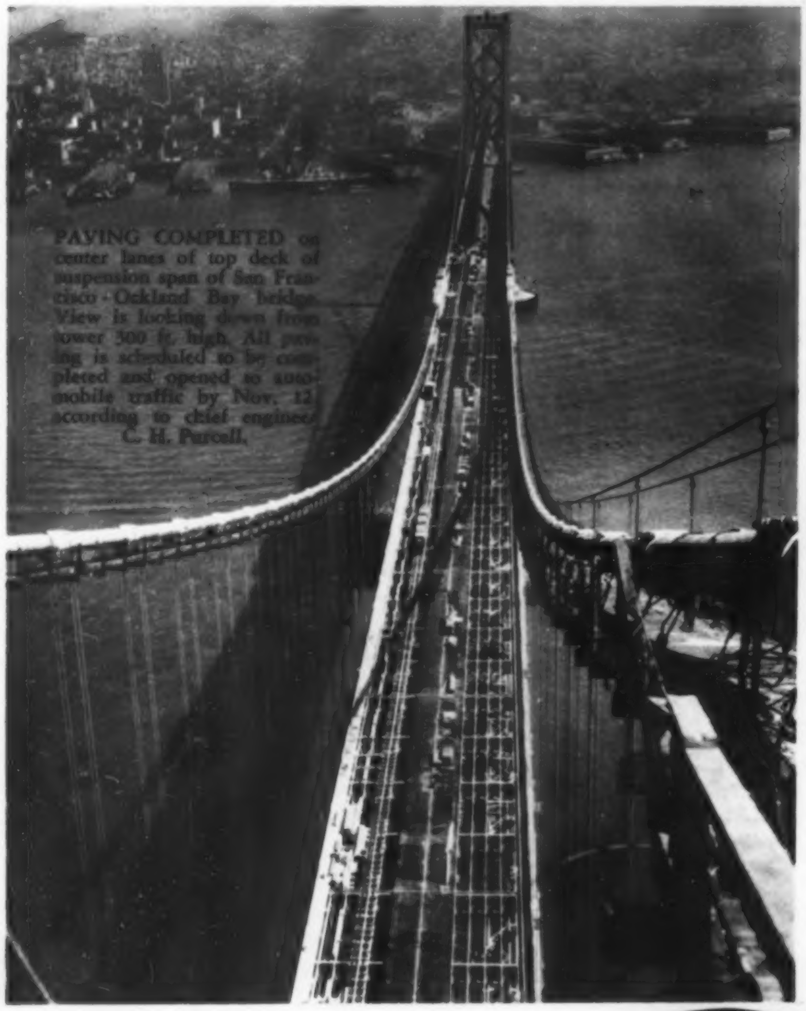
In Fact and Fancy

THE RECENT OPENING of the $60,300,000 Triborough bridge and connections in New York City, linking the boroughs of Manhattan, Queens and the Bronx, inspired Will B. Johnstone, cartoonist for the *New York World-Telegram,* to suggest several solutions, reproduced herewith, to the problem of routing traffic across that structure. The 3½-mi. length of main bridge extends from Queens across the Hell Gate section of the East River and, via Ward's Island, to Randall's Island where, at an elaborate traffic circle, with no crossings at grade, one fork leads to Manhattan and the other to the Bronx. The accompanying illustrations show the intersection as actually built and as it might have been designed.

Cartoon, Johnstone in New York World-Telegram
Photo, Rudy Arnold

BONNEVILLE DAM *(right)* takes form as main feature of federal power, navigation and flood control project on Columbia River in Washington. View, looking northwest, shows upstream side of south half of main dam and Washington shore, with cofferdam in place for north half of dam. Project is under supervision of Corps of Engineers, U. S. Army.

PAVING COMPLETED on center lanes of top deck of suspension span of San Francisco-Oakland Bay bridge. View is looking down from tower 300 ft. high. All paving is scheduled to be completed and opened to automobile traffic by Nov. 12 according to chief engineer C. H. Purcell.



This Month's

"NEWSR

NEW MANHATTAN TOWER, *(below)*. Approach to river crossing of Triborough bridge, New York City, where huge lift span was recently opened to traffic. Lift span is 310 ft. long and can be raised 80 ft. for passage of ships. Steel towers on concrete piers reach height of 220 ft.

WATER STARTS through first turbine at Boulder Dam *(right)* when President Franklin D. Roosevelt *(above)* pressed golden key Sept. 11 during ceremony at Third World Power Conference in Washington, D.C. Water was released as part of test of 12 needle valves, 6 located in outlet house on each side of canyon of Colorado River.

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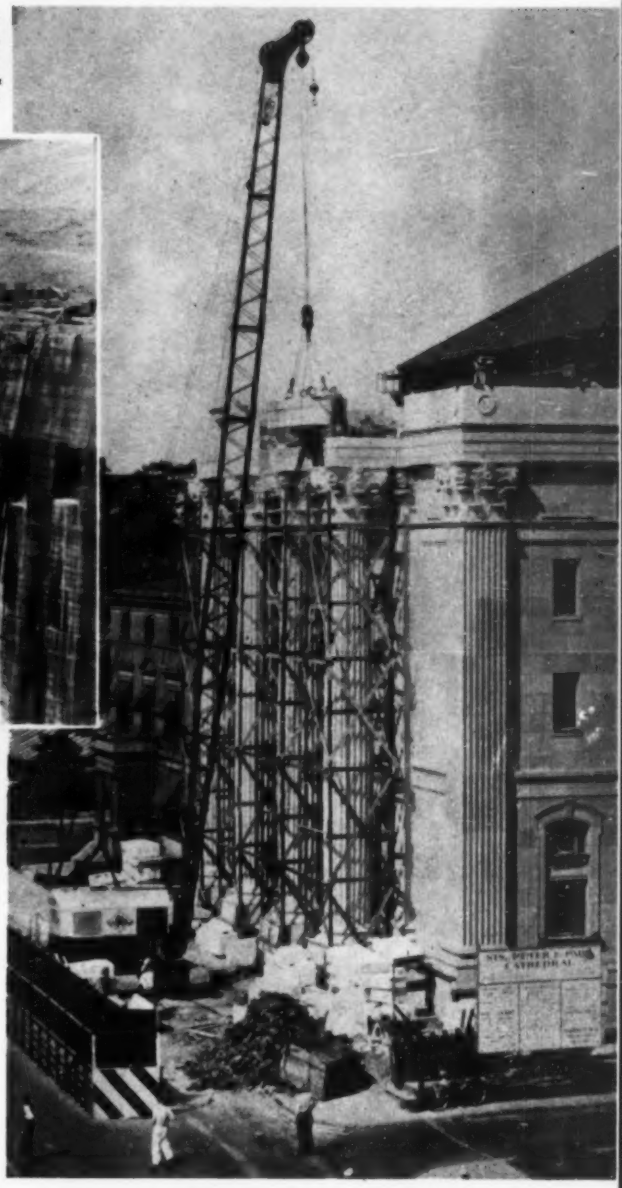
LONG BOOM *(right)*, extending to height of 100 ft. and working at 26-ft. radius, enables Lima crawler crane, owned by F. W. Owens, of Louisville, Ky., to lift and place massive stones on Saints Peter and Paul Cathedral, Indianapolis. Each stone weighed 20 tons, and was lifted to place 60 ft. above sidewalk. For heavy lifts 6-part line was used, and for lighter loads, such as brick, mortar and small stones, crane was rigged with single line.

FORT PECK FACADE. Intake portals of four big diversion tunnels for world's largest earthfill dam at Fort Peck, Montana, being built under direction of Corps of Engineers, U. S. Army. With initial construction financed by $49,881,000 from Public Works Administration, big dam will irrigate 50,000 acres of land, control floods on Missouri River and deepen it to an 8-ft. channel for navigation.



REEL"

INDUSTRIAL WATER SYSTEM *(left)* for Birmingham, Ala., now under construction, involves 60-in.-diameter welded steel pipe line 27 mi. long and about 12 additional mi. of 42- to 54-in. steel pipe, all supplied by the Chicago Bridge & Iron Works. The cost of the project, including a dam about 180-ft. high, will be approximately $6,000,000; it is a joint PWA-WPA undertaking and will provide 60,000,000 gal. of cheap water daily for industrial purposes. Field joints in the steel pipe line are being made with Dresser couplings.

MASS HOUSING in Indianapolis. Lockefield Gardens apartments *(below)*, project of the Housing Division of PWA, is nearing completion by N. P. Severin Co., Chicago contractor. Project includes 748 apartments in 24 buildings. Construction involves load-bearing walls, reinforced concrete floors, plain tile dividing partitions between apartments and metal lath and plaster for intermediate partitions. Exteriors are of face brick with limestone sills. Low bid on project amounted to approximately $2,500,000.

CONCRETE LINING for one of the diversion tunnels at Fort Peck dam in Montana, as illustrated on this page in August, was placed by a Press-Weld concrete placer, supplied by the Pressed & Welded Products Co., of Pittsburgh, Pa., and not by a Pumpcrete outfit, as incorrectly stated.

COMPLETED TRENCH showing bell holes dug by trench excavator.

TRENCH EXCAVATOR working up an incline near Baden.

60-Inch All-Welded Pipe Line

Carries Additional Water Supply to San Francisco

CONSTITUTING the major part of an extensive modernization program for increasing and improving the water supply of a large commercial and industrial area of San Francisco, Calif., the San Francisco Water Dept. is making good progress on the new pipe line now under construction, known as the Crystal Springs Pipe Line No. 2. When completed, it will extend from the Crystal Springs dam near San Mateo, Calif., to the University Mound reservoir in San Francisco, following closely the existing 44-in. steel pipe built in 1885.

Capable of delivering 21 m.g.d., this pipe has in recent years operated at capacity to meet the demands of the University Mound district which it serves through a 60-million-gallon reservoir situated in the southernmost part of that area. The district comprises the large downtown business and industrial section, including the entire waterfront from Hunter's Point to the Marina, and utilizes 40 per cent of the water consumed in San Francisco. Construction of a second independent pipe line became essential as the consumption approached the capacity of the existing pipe now more than 50 years old, certain sections of which are more or less in continual danger of rupture by ground movement, made an adequate and continuous supply of water for this important district questionable. The new pipe line will provide an additional capacity of about 60 m.g.d., discharging into the new concrete-lined 85-million-gallon reservoir now nearing completion at University Mound. With the existing 60-million-gallon reservoir, water storage at this point is sufficient to supply the entire University Mound district for about one week.

L. A. McATEE, construction engineer, San Francisco Water Department (left), supervising work in the field, and K. J. Kennedy, superintendent, Youdall Construction Company, general contractor (right).

TRENCH EXCAVATOR operating near Baden, just west of El Camino Real. Level roadway in foreground is prepared by bulldozer. At left helper is adjusting stakes and plumb line on excavator.

Two Pipe-Installation Contracts — The total length of the new pipe line is about 103,000 ft. Of this figure nearly 4,600 ft. will be tunnels, and for about 16,400 ft. an existing 54-in. pipe line will be used. New construction requires 82,000 ft. of 60-in. pipe, which is to be installed under two separate contracts. The first contract, extending from a point near Millbrae to the University Mound reservoir and comprising 56,000 ft. of 60-in. welded steel pipe, was awarded to the Youdall Construction Co., of San

Francisco for $1,303,624.50. Actual work on this section was started about May 1, 1936.

Bids for the second portion of this line, extending from Crystal Springs dam to a point on El Camino Real in Burlingame, Calif., will be called for in the near future. This section will require about 25,000 ft. of 60-in. pipe, and 650 ft. of 78x½-in. pipe to be installed in the 10-ft. horseshoe section outlet tunnel at Crystal Springs dam recently completed by MacDonald & Kahn Company, Ltd., San Francisco, at a cost of about $60,000. The tunnel work in the area between Millbrae and University Mound reservoir has been completed under separate contract by Barrett & Hilp, San Francisco. It consists of three 5-ft. tunnels, steel lined, 1,430, 330, and 2,290 ft. respectively, and costing about $211,000. Funds for the entire project were provided through a bond issue and a grant allocated by PWA.

In carrying out the contract No. 1, involving the installation of 56,000 ft. of 60-in. steel pipe, Youdall Construction Co. broke up the program into subcontracts. Western Pipe & Steel Co., of California, is responsible for the manufacture, laying and welding the 60-in. steel pipe. The 30-ft. lengths of pipe are made at the company's plant at South San Francisco. The material used is ⅜-in. steel plate with a tensile strength of 55,000 lb. per sq. in. All longitudinal seams in the pipe are welded by automatic welding machines, care being taken that each completed weld is accurately centered, of uniform cross-section, and free from gas holes, porous places, and slag inclusions. Prior to being tested under an internal hydrostatic pressure that will stress the pipe to 20,000 lb. per sq. in., each pipe section is rounded up and marked at the end to facilitate construction in the field. All units found satisfactory by the inspector are coated inside and out with bituminous enamel before an automatic wrapping machine places an unbonded felt wrapper on the exterior of the pipe. A 3,000-ft. section of the main exposed to adverse soil conditions will be protected by a ¾-in. mortar covering.

Trenching Operations—In the field, the main is laid in a trench mostly in sandy soil and covered with a minimum of 2.5 ft. of earth below the subgrade of the surface. Before starting trenching operations, and after the preliminary survey has been made, a bulldozer is operated to provide a smooth roadway for an Austin trench excavator following a short distance behind. This arrangement has materially increased the digging speed by obviating periodic shutdowns for leveling the excavator and adjusting the guide and plumb lines. The entire crew on the digging machine consists of an operator and a helper, who, besides being responsible for the maintenance of the excavator, also advances and adjusts the guide lines while the machine is in motion. Another departure from standard practice is the digging of bell holes by the trench excavator. This is accomplished by gradually lowering the moving bucket line while the excavator is at rest at points designated by survey stakes.

Pipe Installation — Pipe-laying operations are started as soon as a trench sufficient in length to accommodate several pipe sections has been dug. The 30-ft. lengths of steel pipe are delivered under contract on large trucks fitted with three padded saddles to prevent injury to the exterior wrapping of the pipe. At the construction site each pipe section is first secured to the hook of a P & H crawler crane by

30-FT. LENGTH of 60-in. welded steel pipe held by wide Manila rope band attached to hook of portable crane is ready to be lifted from truck and lowered into trench.

PORTABLE CRANE is lowering 30-ft. length of 60-in. welded steel pipe into trench. Truck is equipped with three padded saddles to prevent injuries to wrapped exterior of pipe while being hauled from factory.

WELDING JOINT of 60-in. pipe in trench after circumferential ends have been properly aligned.

OPERATOR wearing gas mask is applying bituminous primer to welded joint.

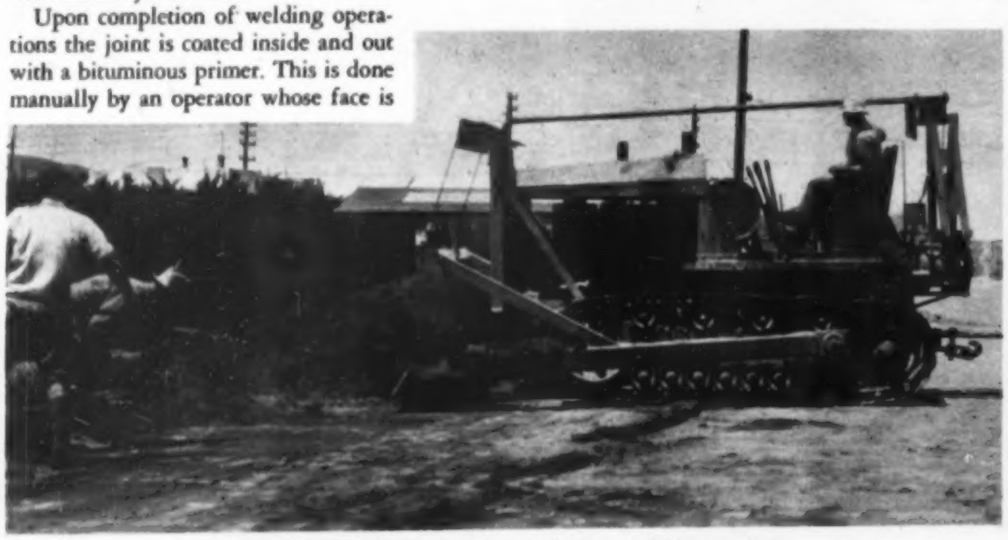
TESTING finished pipe joint with electrical spark gap flaw detector.

a Manila rope band, then raised from the truck and slowly lowered into the trench. In level territory the main is laid in 60-ft. sections prepared at the plant.

Welding the Joints — After the circumferential ends of the pipe in place and the section just lowered have been properly leveled and adjusted, welding of the joint proper commences. Current for the welding unit held by the operator is generated by a welding machine, mounted on skids fitted with steel shoes, which is towed along the side of the trench by a small tractor. To prevent injuries to eyes and hands, the operator is provided with a mask and asbestos gloves. The joint is welded inside and out in about 4½ hr., the operator using Fleetweld rods exclusively. Cutting of the pipe is done with an acetylene torch.

FELT WRAPPING is placed on finished pipe joint.

Upon completion of welding operations the joint is coated inside and out with a bituminous primer. This is done manually by an operator whose face is protected at all times by a special gas mask. Next, the completed section of the main is prepared for a test under hydrostatic pressure sufficient to produce a stress of 16,500 lb. per sq. in. in the metal of the lowest section under test. While the pipe is under pressure all joints are inspected with a spark gap flaw detector. The length of the section tested is usually 5,000 ft. All joints approved by the inspector are first coated with a 3/32-in. layer of bituminous enamel and then provided with an unbonded felt wrapper. Both operations are performed by hand. All men engaged in welding or painting and wrapping the pipe joints wear rubber-soled boots to avoid damage to the pipe wrapping.

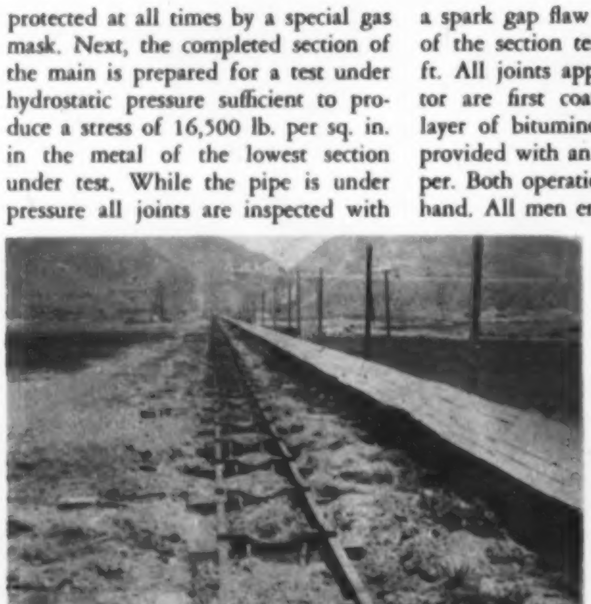


BULLDOZER filling in trench containing tested pipe section.

CREW responsible for laying, welding and inspecting pipe. Left to right: Charles Anderson, superintendent, Western Pipe and Steel Co., of California; W. P. Davis, in charge of surveying, San Francisco Water Dept.; D. Southard, time keeper; E. W. Koehler, enamel inspector, and A. Thompson, welding inspector.

Backfilling — In backfilling, water tamping is practiced where sandy soil prevails. This is done in two operations. First, each bell hole is filled with sandy material by a clamshell, then covered with a stream of water and allowed to settle. Some time later a second stream of water is directed into the trench, which is followed by filling in of earth by a bulldozer. During these operations the entire pipe section is kept under moderate pressure to prevent any deformation of the circular pipe profile.

The portion of the main across Guadalupe Valley will be installed on a wooden trestle, and will be protected from atmospheric conditions by a wooden housing. The trestle consists of a series of bents, spaced with 16-ft. centers, resting on three pile heads. The center pile is driven vertically while the two side piles are on a 1 to 5 batter. Every fifteenth bent is a brace bent which contains 4 brace piles on a 1 to 2 batter. All piles have a bearing capacity exceeding 40,000 lb. The cap is made from 12x12-in. Redwood timber, and the saddle fitted with a steel friction plate is 10x12-in. Redwood timber. In normal ground untreated Douglas fir piles are used, but piles of like material treated with creosote are driven in territory subject to tidal action and in brace bents. All through bolts, drift bolts, nails and spikes used in the construction of the trestle are made galvanized.



WOODEN TRESTLE *(left)* at Brisbane ready to receive 60-in. steel pipe main. Paralleling the trestle is the old 44-in. steel pipe protected by wooden housing.

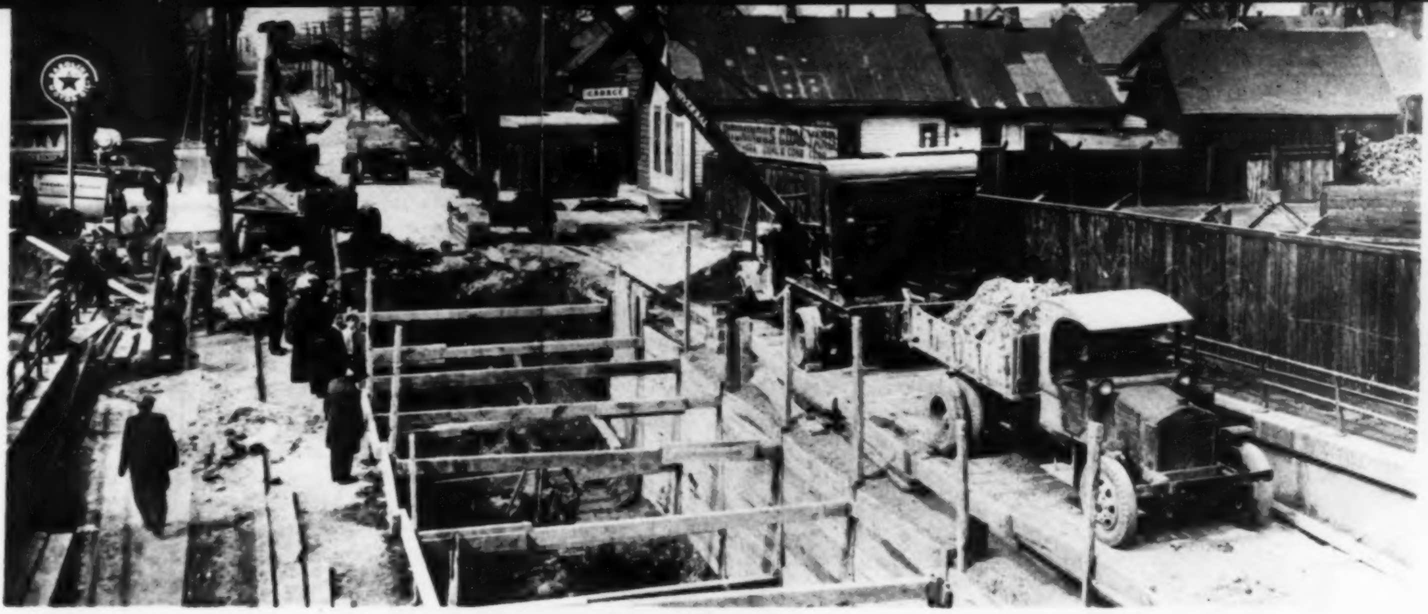
Supervision — Plans and specifications for the project were prepared under the general direction of N. A. Eckart, general manager and chief engineer of the San Francisco Water Department. Construction is being carried forward under broad supervision of L. T. McAtee, utilities engineer, with L. A. McAtee, construction engineer, directing operations in the field.

For the Youdall Construction Co., general contractor, K. J. Kennedy, superintendent, directs the work on the project, and for the Western Pipe & Steel Co., of California, subcontractor, Charles Anderson, superintendent, is actively in charge of pipe laying and welding. W. P. Davis is in charge of surveying, and A. Thompson and E. W. Koehler are welding and enamel inspectors respectively.

Quantities and Prices

QUANTITIES — Principal quantities involved on the project are: Excavation, 129,400 cu. yd. Sand backfill for excavation in paved roads and streets, 13,000 cu. yd. (otherwise excavated material is backfilled into trench). Total tonnage of pipe (exclusive of coating), 6,800 tons.

PRICES — Principal bid prices were: Furnishing and laying 60-in. welded steel pipe of 5/8-in. plate, $13.85 per linear foot. Steel pipe specials, 15¢ per pound. Bituminous enamel coating and lining, 8¢ per square foot. Class I earth excavation (in streets and roadways) for trench up to 9 ft. deep, $2.50 per cubic yard (including backfill) on Section A and $1.90 on section B. Class I earth excavation for trench below 9 ft. deep, $3 on Section A and 60¢ on section B. Class 2 excavation (in open country) for pipe trench, 70¢ per cubic yard. Earth excavation for footings and structures, $2 per cubic yard. Additional rock excavation, $1 per cubic yard. Sand backfill, $1 per cubic yard.



Driven H-Beams and Horizontal Sheeting

Retain Sides of Large Sewer Trench

A SYSTEMATIC and skilfully planned attack upon the manifold problems of a large, partially completed sewer project enabled the Cornell Contracting Corp., of New York City, to make rapid progress in completing for the Sewer Department of the City of Buffalo a rectangular reinforced-concrete storm water relief drain which had been left in unfinished condition by default of a previous contractor. Because of the uneven stage of construction of various portions of the project as abandoned by the original builders, the contractor was under some difficulty at the start in coordinating operations while closing gaps in the work already performed. For the construction of 1½ mi. of rectangular sewer under its contract, the Cornell Contracting Corp. made an open cut in earth and rock and retained the sides of the trench with horizontal timber sheeting installed between vertical H-beams driven in advance of excavation. The rectangular sewer sections measure 16x10¾ ft. and 8½x9 ft. in interior dimensions.

Features of Project — As indicated by the accompanying plan, the storm drain built under this contract extends north almost continuously for 1½ mi. from the Buffalo River, principally in Smith and Gibson Sts., to a connection at Lovejoy St. with the section completed under the defaulted contract. In a total length of about 7,200 ft. of new sewer construction, about 3,200 ft. is 16x10¾-ft. section, and 4,000 ft. is 8½x9-ft. section. Construction called for 18,700 cu. yd. of concrete, reinforced with 1,200 tons of bar steel. Trench excavation amounted to 54,000 yd. of earth and 13,000 yd. of rock.

1½-YD. BACKHOE excavates sewer trench, exposing H-section posts driven in advance. Men at left are puddling fill behind sheeting to assure uniform bearing against timbers and avert future settlement.

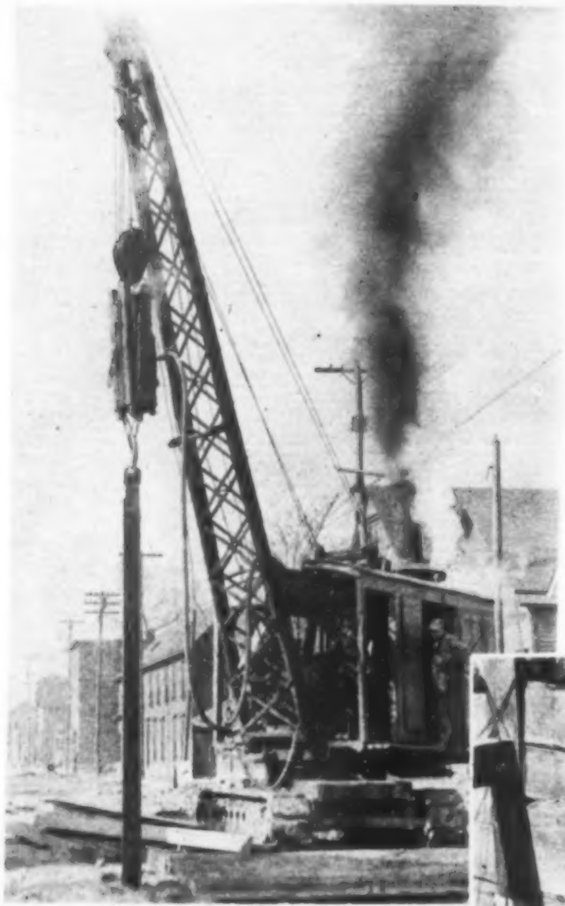
Engineers of the Sewer Department designed sections of various strengths to take care of a variety of loading conditions along the route of the storm drain. The accompanying plan indicates the design section employed for each portion of the project. Considering first the various designs for the 16x10¾-ft. sewer, the regular section has 14-in. walls, a 21-in. invert, and a 20-in. roof. Under Seneca St. and a Pennsylvania Railroad bridge, the plans provide a heavy section with 17-in. walls, 27-in. invert and 27-in. roof. Where the storm drain crosses under eight live tracks of the Erie Railroad, the design specifies a special heavy section of the same dimensions with additional reinforcement.

Only two designs were required in the smaller sewer size. The regular section has 12-in. walls, a 13-in. invert, and a 12-in. roof. Along the New York Central Railroad embankment, the engineers decided upon a heavy section with 12-in. walls, 16-in. invert and 15-in. roof.

In addition to the sewer sections already described, the contract includes 63 ft. of 8½x8½-ft. sewer, extending north from the siphon at Lovejoy St. to a connection with the completed portion of the drain.

As indicated on the plan, siphons are called for at three other locations where the new storm drain intercepts existing sewers, namely, at Peckham

1½ MILES of large reinforced-concrete storm drain is completed by Cornell Contracting Corp. after short scattered sections had been built by previous contractor who defaulted.



BY REVERSING double-acting steam hammer *(left)*, crane used for driving extracts steel H-section posts from completed sewer section.

PAPER LINING *(left)* on faces of steel H-section posts prevents bonding to sewer wall concrete placed against sheeting and facilitates pulling of posts.

St., at Broadway, and at Sycamore St. At each of these intersections, as well as at Lovejoy St., the design provides an inverted siphon of cast-iron pipe under the new drain to carry sanitary sewage, and a junction chamber with an overflow weir to divert storm water to the new sewer.

More difficult siphon construction is involved in carrying the new storm drain under an existing sewer beneath the pavement of Seneca St., which is elevated on an earth fill retained between stone masonry walls. The existing Seneca St. sewer is roughly semicircular in shape, with a brick arch 10 ft. in diameter, a wooden plank bottom and masonry walls to springing line.

Job Organization — A coordinated construction schedule had to be worked out to enable the contractor to close gaps in those portions of the work already partly constructed and to complete $1\frac{1}{2}$ mi. of new rectangular sewer in 200 calendar days, which was the time limit set by the contract. Under this schedule, progressive trenching and sewer construction operations were carried on simultaneously at two places in the 3,200-ft. length of $16 \times 10\frac{3}{4}$-ft. sewer and at one point in the 4,000-ft. length of $8\frac{1}{2} \times 9$-ft. sewer. In addition, one crew was engaged in building the siphons for the four intercepted sewers and a second crew in constructing the siphon in the new drain under Seneca St. and the existing sewer at this location. Additional forces were employed in completing small gaps near the river, in replacing a short section of 48-in. water main crossing above the new drain in Perry St., and in paving streets above the completed sewer. None of the paving had been done by the previous contractor, and this item in the Cornell contract amounted to 30,000 sq. yd., requiring 5,500 cu. yd. of concrete.

In organizing these operations, the contractor attempted to complete the various portions of the work in their entirety as construction progressed. Some difficulty in coordinating operations to obtain this result was caused by the unbalanced condition in which the previous contractor left the project. As the sewer construction was financed with PWA funds, the contractor at the start labored under the additional difficulty of training workmen supplied from local lists of unemployed by the National Reemployment Service. About 8 weeks was required to bring the construction crews to a point where they could be relied upon to proceed effectively without constant supervision by the contractor's superintendent.

Trenching and Sheeting — For the larger sewer section, total depth of excavation ranged from 15 to 24 ft., with the cut in rock varying from nothing to about 14 ft. (at the Seneca St. siphon). The average cut was about 17 ft. deep, and the average depth of rock in the bottom of the cut (for the 2,850 lin. ft. of trench which has a rock bottom) was about 3 ft. In the 4,000 lin. ft. of $8\frac{1}{2} \times 9$-ft. sewer, the average cut was about 18 ft., and the average depth of rock for the entire 4,000 ft. was 4 ft. For 1,700 lin. ft. of this section, the average depth of rock above subgrade was 5 ft. The earth encountered in the trenching operation is principally clay and clayey sand, and the rock is a hard, flint-like deposit which shatters in jagged pieces when blasted.

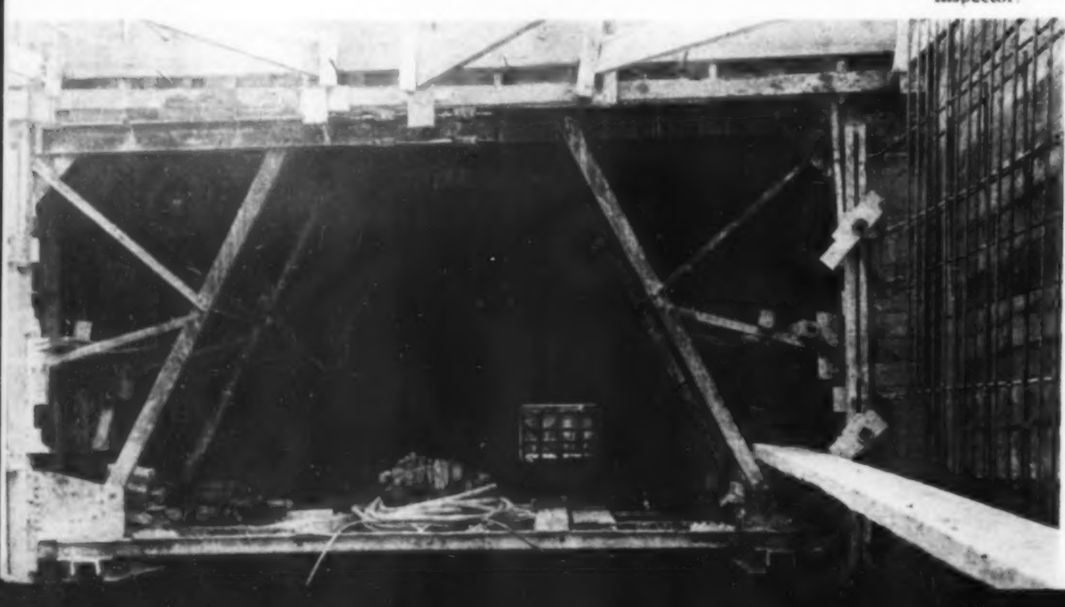
To retain the sides of trenches excavated in earth, a subcontractor drove in advance of excavation 8-in., 33-lb. H-section piles on 10-ft. centers 2 in. outside neat lines along the two edges of the trench. The contractor then installed horizontal timber sheeting between the H-columns as digging proceeded. For the temporary columns the contractor utilized about 300 H-sections, 21 ft. and 24 ft. long. The piles were driven and pulled for repeated

DIRECTING OPERATIONS *(left to right)* for Cornell Contracting Corp. are J. J. Joyce, clerk; Howard Depew, superintendent; Andrew B. Carlin, paymaster; Charles E. Carlin, project manager;—and for Buffalo Department of Public Works, Joseph J. McMahon, engineer and chief inspector.

use by a steam crane and a double-acting hammer which was reversed for the extracting work.

As trench excavation was carried down to subgrade, the contractor installed cross-bracing of 10x10-in. hardwood struts wedged between the H-columns. These struts were suspended by wire hangers from the tops of the columns as a precaution against dropping in case of any movement in the sheeting. In open areas where only ordinary ground pressures had to be resisted, the sheeting consisted of 3-in. hardwood planks; but in places where retaining walls or railroad tracks imposed additional loads or stresses, the thickness of sheeting was increased to 5 in. Under the Erie Railroad tracks, the spacing of H-columns was reduced to 8 ft. to give additional stability.

Driving the H-columns 2 in. out-



TRAVELING STEEL FORMS *(left)* mounted on flanged wheels riding on rails are moved forward by winding steel hauling rope on air hoist bolted to frame of working platform. Four 20-ft. form sections are bolted together to make 80-ft. unit for concreting walls and roof on tangent.

side neat lines allowed for deflection in the horizontal timber sheeting under earth pressure and also provided some tolerance for H-piles which drove slightly out of plumb. This practice was more economical than to attempt to install the sheeting closer to the neat lines of the structure. The inside flanges of the H-columns were covered with paper to prevent bonding to the concrete and to facilitate extraction.

Earth Excavation — Two $1\frac{1}{2}$-yd. Northwest backhoes, a Speedcrane and a Marion gas-electric crane (the latter two handling 1-yd. clamshell buckets) excavated trenches in earth, loading the spoil into 7- and 8-yd. trucks for disposal. Timber sheeting was installed between the vertical H-beams as excavation went down.

Rock Excavation — A central compressor station housing an electrically-driven two-stage compressor was located at Fillmore St. on the south side of the New York Central Railroad embankment. A pipe line supplied air from this station to all parts of the contract north of South Division St. Air for drilling at other points was furnished by five portable compressors.

Thirty Chicago Pneumatic hand-held drills sank vertical holes for blasting the rock bottom of the cut, using Ingersoll-Rand and Timken detachable bits on the drill stems. Holes were spaced 2 to 3 ft. apart in both directions across the entire width of the cut and were drilled about 12 in. apart along the edges of the trench to assure a clean break of the flint-like rock. The holes were sunk to 6 in. below subgrade and were loaded with $\frac{1}{4}$ to 1 stick of 40 per cent dynamite, depending upon the depth of the rock, which varied up to a maximum of about 14 ft. The rock broke sharply into jagged pieces which were handled readily into skips and a special rock-handling clamshell bucket for removal from the cut by the crane.

Concreting — For the $16x10\frac{3}{4}$-ft. sewer the contractor used six 20-ft. units of Blaw-Knox steel arch forms, which usually were bolted into one 80-ft. section and one 40-ft. section. When constructing sewer on tangent in earth and rock cut, the engineers permitted the contractor to concrete 80 ft. of arch in one continuous pour. To move steel forms overland from one portion of the sewer to another, a Speedcrane picked 20-ft. sections weighing $7\frac{1}{2}$ tons each out of the trench and carried them to the new location.

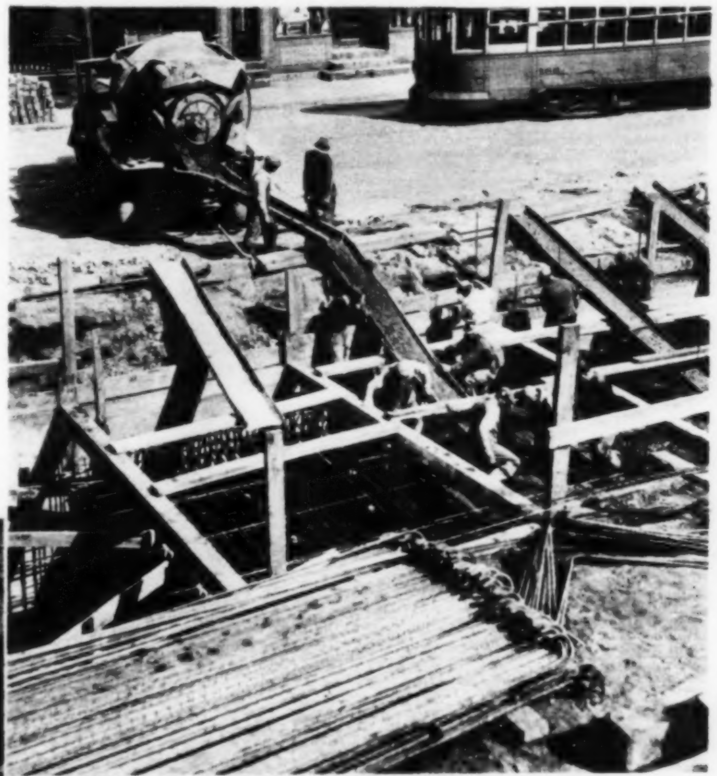
When moving the 80-ft. form section forward to a new set-up in the trench, an efficient crew of six men and a foreman shifted the entire unit to the new location and jacked it to position for the next pour in 5 hr. Systematic work on the part of the crew, with each man performing definite operations assigned to him, made this speed possible. An air hoist mounted on the working platform of the steel form unit, which rolled on rails laid on the invert, pulled the form forward by a line through two snatch blocks attached to reinforcing bars some distance in advance.

UNDER EIGHT TRACKS of Erie R.R. bulldozer moves clay to position for handling out of trench by clamshell.

Six 20-ft. form units were available for the $8\frac{1}{2}x9$-ft. sewer. These forms were bolted into three 40-ft. sections. It was necessary at curves to substitute wood forms for steel in both sizes.

Invert steel was supported on precast concrete blocks manufactured to exact dimensions on the job. The blocks were more convenient than hangers, supporting the steel at the desired level and eliminating displacement difficulties during setting of steel haunch forms and concreting of invert.

Concrete was delivered by 4-yd. truck mixers from two commercial batching plants, each about 2 mi. from the sewer. The mixers discharged at the side of the trench into open chutes which placed the concrete directly in the forms. When supplied by eight 4-yd. truck mixers, the concrete crew could complete an 80-ft. arch section of large sewer in 2 hr. In less than 6 hr. on one day the contractor placed 415 cu. yd. in 120 ft. of large-section arch and 80 ft. of heavy invert.



TRUCK-MIXED CONCRETE is delivered by chute directly from drum to forms.

ROCK BOTTOM *(left)* of trench is drilled with pneumatic hand drills, using detachable bits.

Seneca St. Siphon — To carry the flow of the existing sewer in Seneca St., while putting the storm drain under it, the contractor installed a steel flume (conforming to the cross-section of the existing sewer and reinforced with H-beams) after removing the brick arch. As already mentioned, the old sewer at this point is carried in embankment retained between two stone masonry walls. To support these walls above the new siphon, the contractor constructed reinforced-concrete beams spanning between concrete piers at the two sides of the new storm drain. Actual construction of the siphon was carried out by making an open cut across Seneca St., maintaining traffic at all times on 12x12-in. timber decking supported by 26-in. I-beams.

Four Small Siphons — A separate crew equipped with a crane was assigned to the construction of siphons at the four locations where the new storm drain intercepts combination storm and sanitary sewers. The design at each location called for an inverted siphon of adequate capacity to by-pass all sanitary sewage under the new drain, and an inlet into the new interceptor to catch the overflow at times of storm. During construction of the permanent siphon and junction chamber at each of these intersections, the contractor relied upon a 24-in. by-pass of corrugated pipe to carry all but extreme floods in the existing sewer.

Administration — The storm water relief drain was completed with a PWA allotment by the Division of Engineering of the Buffalo Department of Public Works. George J. Summers is commissioner of public works, and John T. Mockler is first assistant engineer in charge of the Division of Engineering. Design and construction of the relief drain were under the immediate direction of C. L. Howell, assistant engineer in charge of the Sewer Department. Joseph J. McMahon, engineer and chief inspector, supervised construction at the site. Earl L. Peterson was resident engineer-inspector for PWA.

For the Cornell Contracting Co., Inc., Charles E. Carlin was project manager, Howard Depew superintendent, and C. A. Ross job engineer.

Step-by-Step Field Methods ~ Concrete House Built for $5,000

1 $5,000 CONCRETE HOUSE, as designed by architects, Burnham Bros. & Hammond, Inc.

2 EXCAVATION *(left)* was started in mid-winter (February, 1936).

3 UNDER PROTECTIVE TENT *(right)* forms and reinforcement are placed for basement walls and footings.

PURDUE UNIVERSITY, through its Research Foundation, established last year a Housing Division with the objective of building and studying construction and maintenance costs and methods for experimental houses in the $5,000 price class, each structure to include three bedrooms, attached garage and modern equipment. There are five types of construction represented in the first group of houses now completed on a woodland site outside of West Lafayette, Ind., near the University. Among the first to be finished is the reinforced concrete structure which is the subject of the accompanying step-by-step illustrations, indicating in proper sequence the construction procedure followed. Plans for this house were drawn by Burnham Bros. & Hammond, Inc., architects. Its five rooms, attached garage, basement playroom and utility room accommodate a family of four.

4 PLACING *(above)* and tamping concrete for foundation walls, March 7, 1936.

5 PRECAST FLOOR JOISTS *(left)* of concrete were made at a nearby plant.

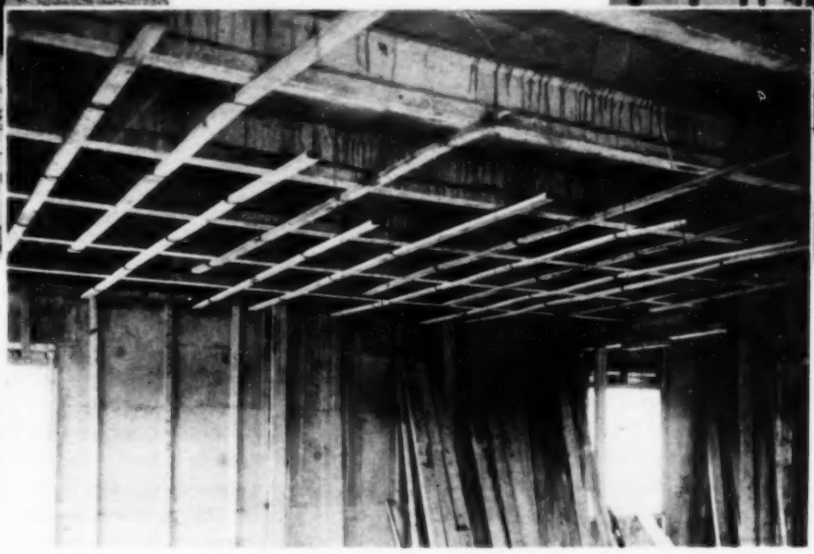
6 NO SHORING! *(right)* Steel forms are set between precast concrete floor joists preparatory to pouring concrete for first floor.

7 **SECTION METAL FORMS** *(right)* are set for exterior walls 6 in. thick.

8 **FINISHING** *(below)* is done on inside wall surface. Note concrete joists overhead.

9 **PLUMBING** *(below)* is installed on first floor. Note furring wall strips in place to provide ¾-in. dead air space between concrete and wall-board and plaster.

As the wall construction reached first floor level, precast concrete joists were set in place. These 8-in. joists, placed 27 in. on centers, made it possible to use metal forms between joists to form the slab. Because of the smooth surface of the forms, no building paper was necessary. The 2½-in. concrete slab was reinforced with 6-in. square mesh.



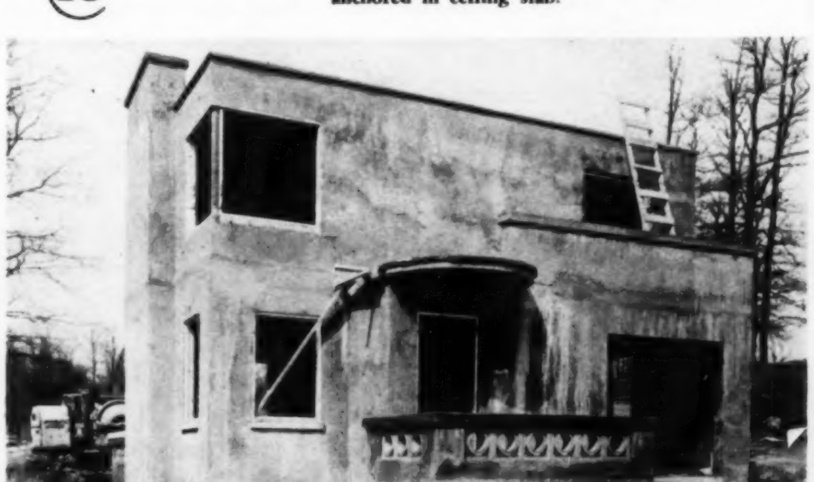
10 **FURRING STRIPS** for ceiling plastering held in place by wire anchored in ceiling slab.

All walls are of reinforced concrete. First and second floors and roof deck are of precast concrete joist and slab construction. The concrete walls (above 8-in. foundation walls) are 6 in. thick and are covered on the inside with ¾-in. furring, ½-in. cane insulation board and ½ in. plaster. The roof and floors are framed with 8-in. precast concrete joists covered with a 2½-in. poured concrete slab. On the roof 1-in. cane fiber insulation board and built-up asphalt roofing are utilized. The cost of the completed house was $4,997.

Construction was begun in midwinter by Charles Gambsky, contractor of Menasha, Wis., who erected a tent to cover and protect the whole wall area and installed a boiler to supply steam for warming the space under the tent and insuring curing of the concrete.

For both interior and exterior walls sectional metal forms were used; they were 2 ft. in height and were graduated from 2 to 22 in. in width. Forms were fastened at the vertical edges with clamps, two to each panel, and on the top and bottom by nails through holes in the flanges.

Interior and exterior faces of forms were spaced for the proper wall thickness by metal spreaders notched to fit in slots in the corners of each form unit. Two spreaders were used at each horizontal form connection.



11 **WALL STRUCTURE** completed. Surface kept damp until cured and rubbed with concrete brick and sand-cement slurry to produce textured surface.

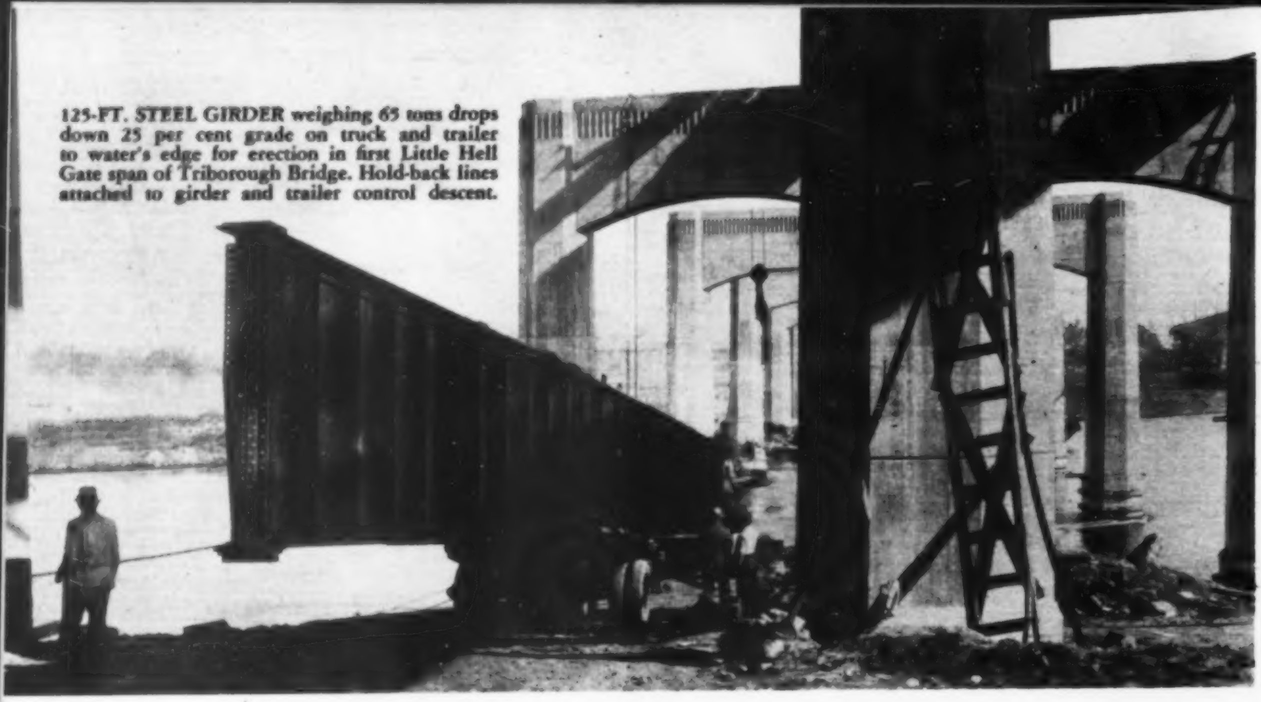
Window and door frames which had been built out to 6 in. (and braced against the weight of the wet concrete) to fit in forms were placed in their proper positions. An additional ⅜-in. reinforcing rod was placed diagonally at the corner of each opening. Five-eighth inch reinforcing rods were placed parallel to each opening at the top and bottom and on the sides.

Forms the full height of the wall were set and reinforcement placed before the concrete was deposited. After the form panels were in place, walers were attached to both top and bottom of each tier of forms.

The first floor slab was next placed, then construction continued for the first floor walls. Similar procedure was followed in constructing the second floor and the roof slabs.

Wall forms were removed as soon as the concrete had hardened sufficiently to bear its own weight, the concrete being kept damp until well cured. Exterior walls were then rubbed with concrete brick and a sand-cement slurry to produce a slightly textured surface. The final finish was two coats of white portland cement paint.

Interior walls were furred out ¾ in., leaving a dead air space between the walls and the ½-in. rigid insulation board to which ½ in. of plaster was applied.



125-FT. STEEL GIRDER weighing 65 tons drops down 25 per cent grade on truck and trailer to water's edge for erection in first Little Hell Gate span of Triborough Bridge. Hold-back lines attached to girder and trailer control descent.

Pneumatic-Tired Carriers

Transport Heavy Girders On Earth Roadway

RIDING on a dozen pneumatic tires, distributed four under the rear end of a truck tractor and eight under a specially designed trailer, 65-ton girders for the Little Hell Gate spans of the Triborough Bridge, New York City, traveled in wet and dry weather over an earth road and down a steep grade to the water's edge, where a derrick on the bridge deck picked them up and set them in the structure. Chosen as a more economical method in place of the railroad transportation originally contemplated, trucking of steel on the long contract of the McClintic-Marshall Corp. (extending for a total distance of more than 2 mi. from the Bronx to Queens across Randall's and Ward's Islands and intervening waterways) required development by Bigley Bros., Inc., of Hoboken, N. J., hauling contractor, of equipment which would assure uninterrupted delivery from the unloading dock to the erection crews in all kinds of weather. Pneumatic-tired trucks and trailers satisfied this requirement.

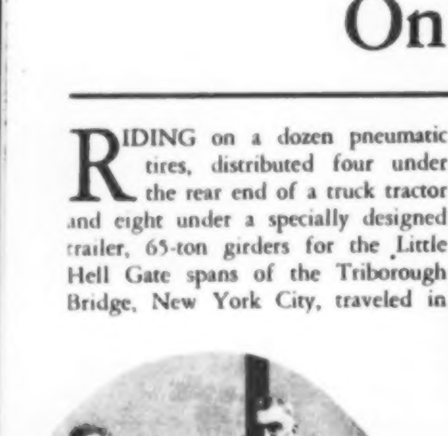
Delivery of the 65-ton girders for the Little Hell Gate spans gave the hauling equipment its severest test. At the end of a $1/2$-mi. haul, the trucks and trailers transporting these girders had to descend a 25 per cent grade for 300 ft. to the edge of the water. In addition to the truck at the forward end of the girder, the load was held back during its descent by a second truck at the rear end and by two sets of block and tackle anchored to columns of concrete bents. One set of tackle was reeved to a power winch on a truck. The live rope of the second set was snubbed around a column and released gradually by two workmen.

Girder Racks — Both trucks and trailers were equipped with adjustable welded brackets, illustrated by a photograph, for transporting the girders in vertical position. These brackets were pin-connected to reamed holes in the bolsters on the trucks or trailers. The opening between the brackets could be adjusted to accommodate girders of various flange widths. Cable ties held down the girders in the racks.

Four trailers were built by Bigley Bros. to transport girders on this contract. Each trailer, weighing about 10 tons, consisted of a heavy welded frame resting on two trunnion-type rocker axles equipped with dual wheels, making four dual wheels in all. These wheels were arranged in a straight line across the width of the trailer. The axles could rotate through a limited angle in a vertical plane but could not be turned in a horizontal plane. Free rocker motion of the axles assured full load-carrying effectiveness of the dual wheels on uneven ground. Each wheel was shod with a 10.50x 24-in. pneumatic tire.

Similar tires were placed on the dual rear wheels of each of the 10-ton trucks used to haul the girders. The bolster supporting the girder on the truck chassis was pinned at the center but was left free to rotate in a horizontal plane on greased steel plates. Only about one-fourth of the weight of the girder was thrown on the truck, the remainder being carried by the trailer, which was spotted near the five-eighths point of the girder to obtain this load distribution.

Transportation Methods — Ward's Island is situated in the East River between the boroughs of Manhattan and Queens. It is separated from Queens by Hell Gate (the steamship channel between New York harbor



IN CHARGE of work on Ward's Island — Bernard F. Bigley (left), vice-president, Bigley Bros., Inc., and Albert E. Facey, general foreman, McClintic-Marshall Corp.

THREE TRUCKS IN TANDEM *(below)* draw 65-ton girder at rate of 6 m.p.h. over earth road through three-column concrete bents on Ward's Island.

HAULING AND ERECTING are respective responsibilities of William J. Bigley (left) president, Bigley Bros., Inc., and M. L. Carpenter, foreman, McClintic-Marshall Corp.

WELDED BRACKETS on revolving bolster at rear end of truck support girder in vertical position. Four pneumatic tires under this end of girder carry about one-fourth of total load.

RAISED CLEAR of truck and trailer girder starts last lap of journey to final position in Little Hell Gate crossing.

SPECIALLY BUILT TRAILER equipped with adjustable brackets and two pairs of dual wheels (eight wheels in all) carries three-fourths of 65-ton load. Girder is being raised clear of trailer by erection derrick. Each pair of duals (four wheels) is mounted on separate rocker axle.

and Long Island Sound), from Manhattan by the Harlem River, and from Randall's Island by Little Hell Gate. Girders for the Ward's Island viaduct were loaded out of ground storage near Jersey City on to railroad cars and were transported on car ferries to an unloading dock at the Hell Gate crossing of the Triborough bridge. Here they were transferred directly to trucks and trailers for transportation to the erecting derrick. Sufficient trucks and trailers always were available to take away the girders as rapidly as they were delivered to the dock.

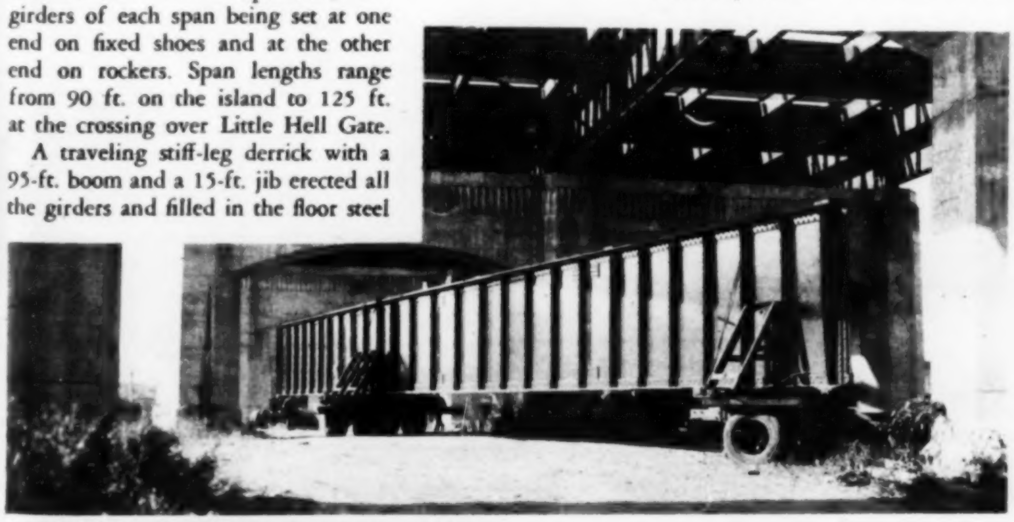
A bulldozer and a 10-ton roller graded and compacted a hauling roadway across the island through the three-column bents of the steel-girder viaduct. Cinders were spread on the roadway at soft spots in the natural clay soil, and planks were used to cross obstructions. Three 10-ton trucks arranged in tandem pulled the heaviest girders over this roadway at a rate of about 6 m.p.h.

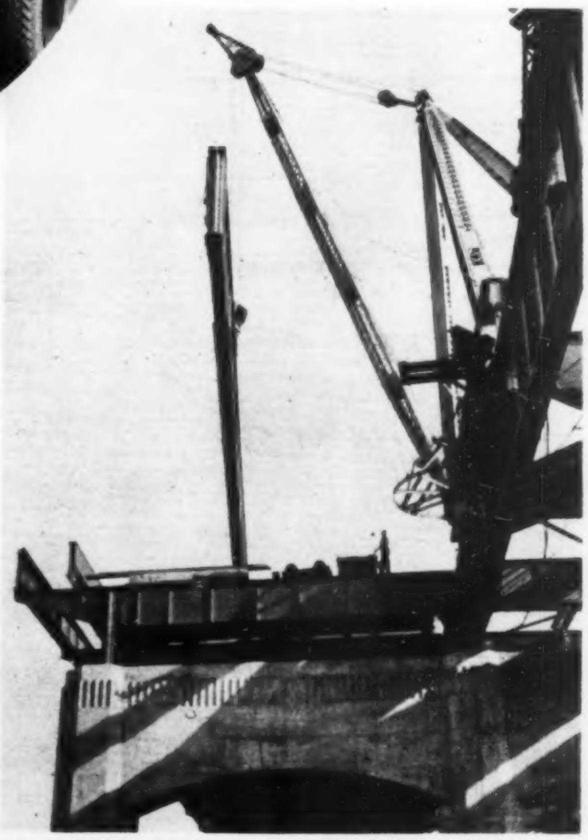
Erection Procedure — Steel spans of the viaduct are independent, the girders of each span being set at one end on fixed shoes and at the other end on rockers. Span lengths range from 90 ft. on the island to 125 ft. at the crossing over Little Hell Gate.

A traveling stiff-leg derrick with a 95-ft. boom and a 15-ft. jib erected all the girders and filled in the floor steel for one-half of the deck. Behind it traveled a smaller stiff-leg which completed the erection of floor steel and set the drain pipes and inlet castings, included in the steel contract on this project. The heavy derrick was set with its mast resting on the center girder and with its back legs anchored to one of the outside girders. Because the outside girder was not tied down, the lifting capacity of the rig was limited to 65 tons, which is the weight of the center girders on the six spans across Little Hell Gate.

Erection started at the Hell Gate end of the viaduct, adjacent to the west anchorage of a suspension bridge crossing this channel, and proceeded from this point to Little Hell Gate. The outside girder of a shore span at Little Hell Gate was omitted to permit the erection derrick to hoist girders for the remaining spans through this opening. By moving forward to erect the three girders of a span and back to hoist the three girders of the succeeding span, the traveling derrick erected steel progressively across the waterway and finally closed the opening in the shore span.

Field Supervision — All steel in the McClintic-Marshall contract was placed under the immediate direction of George C. Lane, engineer of erection. On Ward's Island, erection operations were directed by Albert E. Facey, general foreman, and M. L. Carpenter, foreman. For Bigley Bros., Inc., William J. Bigley is president, and Bernard F. Bigley is vice-president in charge of field work. The bridge was built with PWA funds by the Triborough Bridge Authority, of which O. H. Amman is chief engineer.





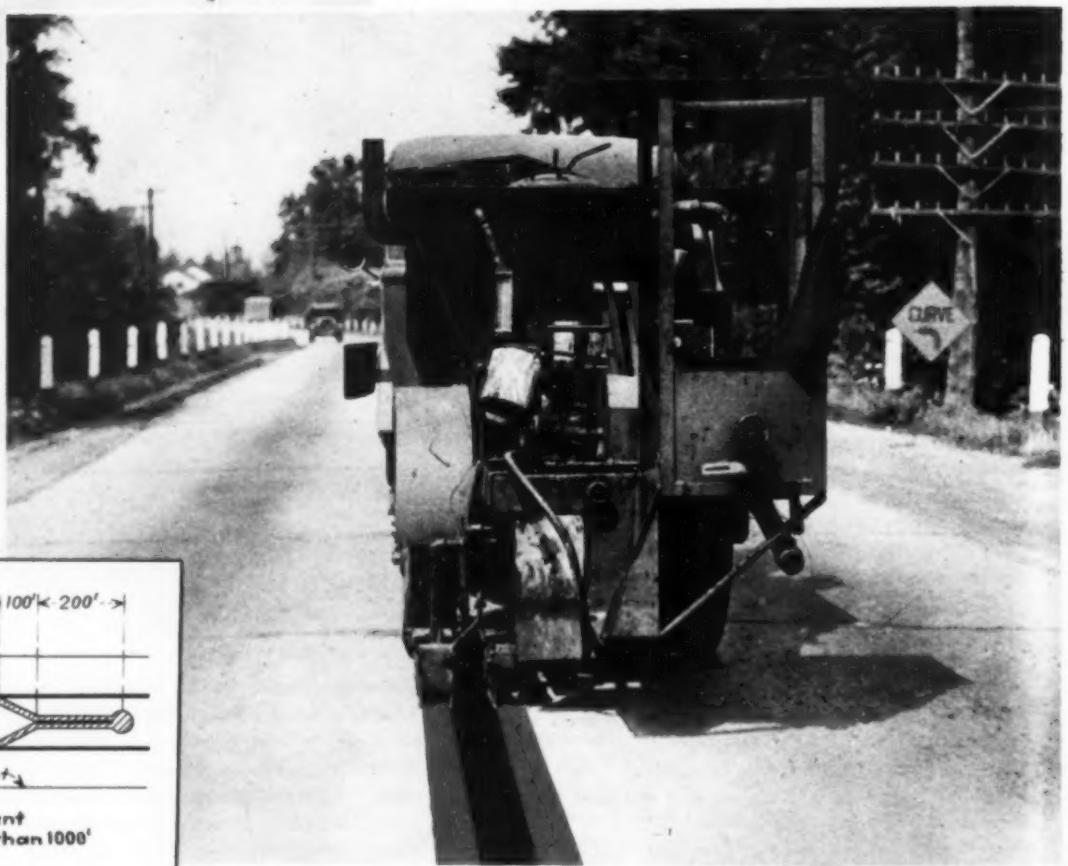
PNEUMATIC TIRES fore and aft *(left)* carry 65-ton girder ½ mi. from unloading wharf to Little Hell Gate. Cab and engine of truck are hidden by concrete column at right.

TRAVELING STIFF-LEG DERRICK raises girder through gap in first span left open for this purpose and carries girder forward to permanent position.

Yellow Lines Mark *"No Passing" Zone*

On Indiana Highways

SPECIAL MARKING MACHINE developed to apply yellow, paint to "no passing" zone lines on Indiana highways.



SHOES *(right)* on either side of black centerline guide application of new parallel yellow stripes.

YELLOW STRIPES, paralleling the black centerline marking over hills and around curves on Indiana's state highway system, will warn motorists that they are in a "no-passing" zone and subject to arrest as reckless drivers if they do not drive on their own side of the highway. Use of the yellow marking to designate hazardous points where motorists should not attempt to pass other vehicles moving in the same direction, is another step taken by the State Highway Commission to make Indiana's highways more safe for motorists.

Using new equipment the special caution marking is being placed parallel to the centerline on curves where there is a change of direction of more than 3 deg. and on all grades where the motorist has a sight distance ahead of less than 1,000 ft. The same marking is being used at other points where some condition exists that makes it hazardous for motorists to pass or attempt to pass other vehicles moving in the same direction.

It has been estimated that between 270 and 300 mi. of state highways will carry the special marking when the program now in progress is completed. It will require about 15 gal. of paint per mile of highway for the new safety lines.

In the application of the two yellow lines at "no-passing" zones, highway officials adapted the special equipment developed for the application of the centerline marker. The centerline markers have been fitted with two "shoes" 4 in. apart, which fit on either side of the centerline. The paint is fed under pressure to brushes in these "shoes" and applied to the pavement. The new safety marking is being done by members of the state highway maintenance department who have received special training in the operation of the equipment.

DETAILS of markings with black and yellow lines at "no passing" zones of several types.

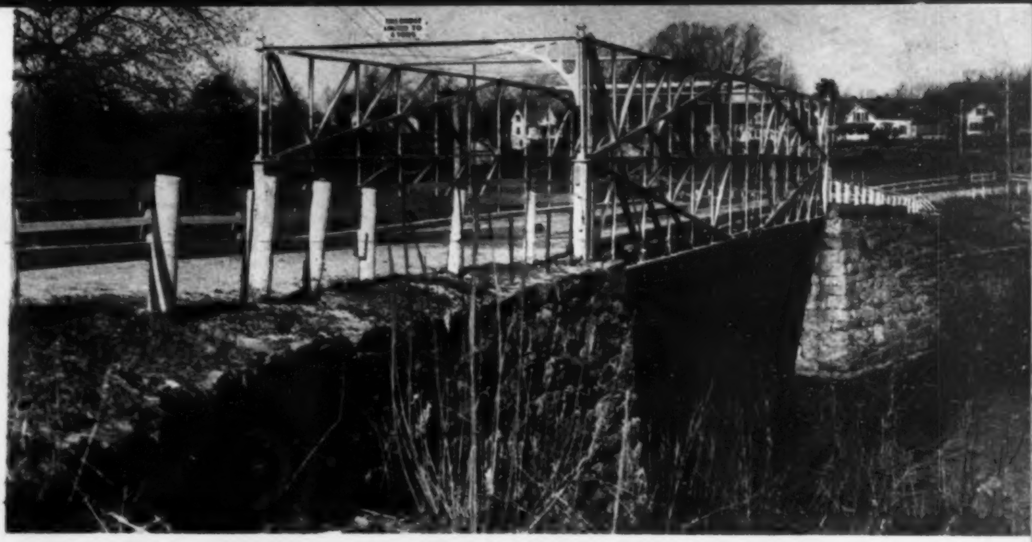
JOB ODDITIES

A MONTHLY PAGE OF

Unusual Features of Construction

POST AND LADDER SCAFFOLD

used by Baltimore house painters has plank runners attached by U-bolts to ladder rungs and anchored by steel rods to turnbuckle spreaders screwed tight in window frame.



OLD IRON TRUSS BRIDGE

of odd design is located just off U. S. Route No. 6 at North Windham, Conn. — *Photo from Armco Culvert Manufacturers' Association.*

A NIAGARA OF EARTH

Bulldozer on Caterpillar diesel tractor (*below*) owned by Griffith Co., of Los Angeles, sends cascade of fill down steep slope to cover completed section of Colorado River aqueduct near Riverside, Calif. On 5-mi. section trench depth varied from 16 to 59 ft.

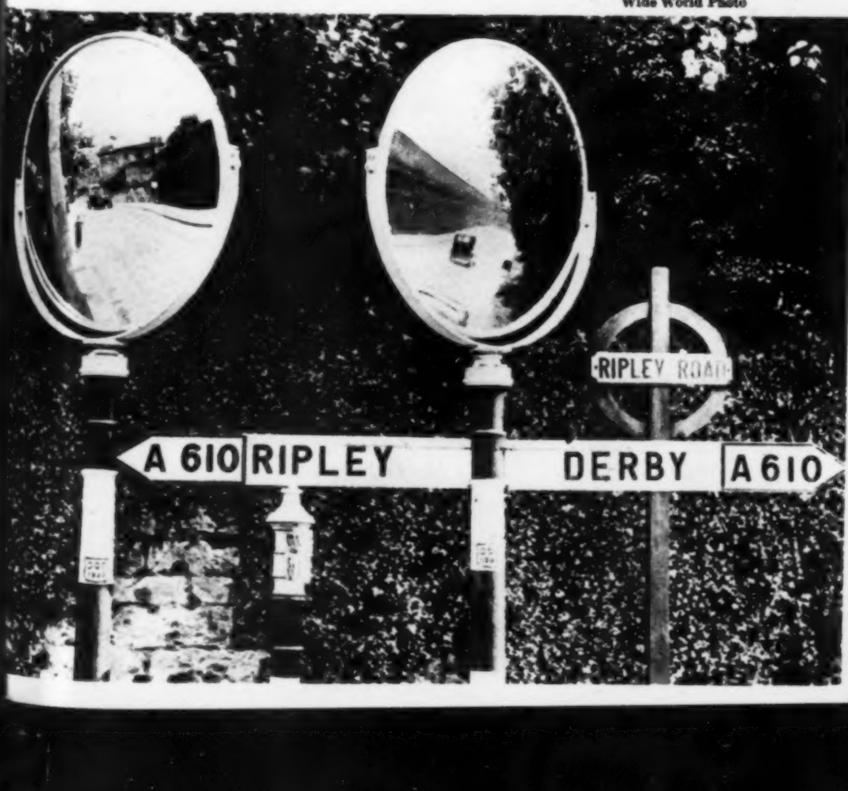
Wide World Photo

UNUSUAL CONNECTION

is made in outfall manhole (*above*) at new sewage disposal plant in Austin, Texas. Crane handles as a unit a 30-in. bell tee with 12-in. bell outlet and an 8½-ft. section of 30-in. plain end pipe. Total weight, 6,500 lb. — *Photo from American Cast Iron Pipe Co.*

SAFETY FIRST ON ENGLISH ROAD

Large mirrors are placed at road intersections (*below*) to enable drivers to see and avoid oncoming traffic.

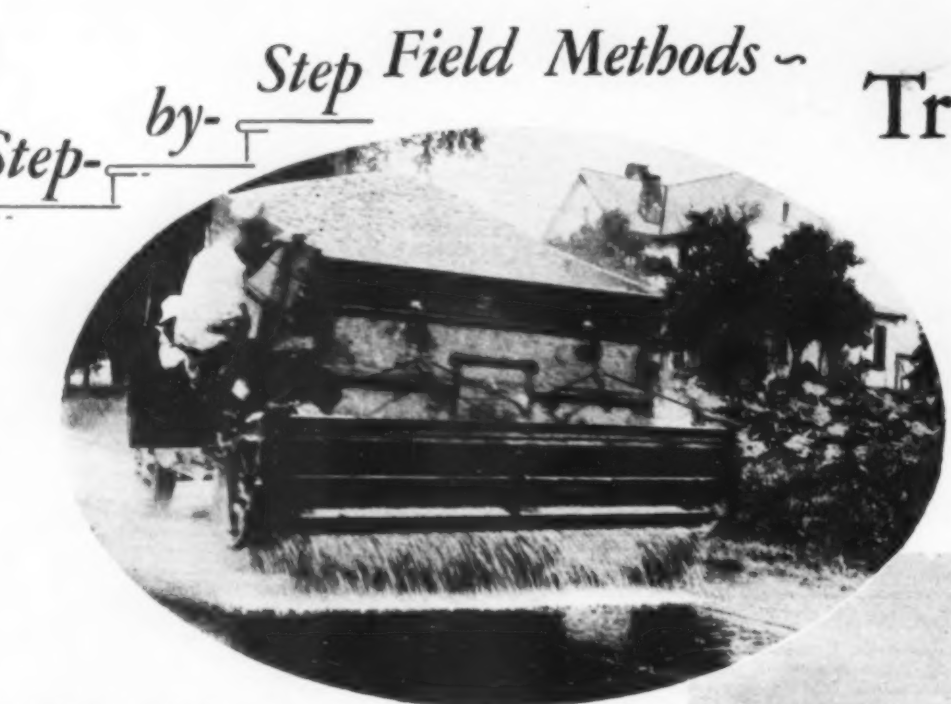


TRAILER GETS A LIFT

Preparatory to transferring power shovel between sections of Skyline Drive, in Virginia, contractor uses high speed pneumatic tired trailer (*above*) to haul 30-ton drop frame low speed trailer distance of 125 mi. to job. Power shovel unloaded 30-ton trailer, climbed upon it, and rode 20 mi. to next job. At destination shovel crawled off, loaded 30-ton trailer back on high speed unit for return journey to construction base. — *Photo from G. Y. Carpenter, Luray, Va.*

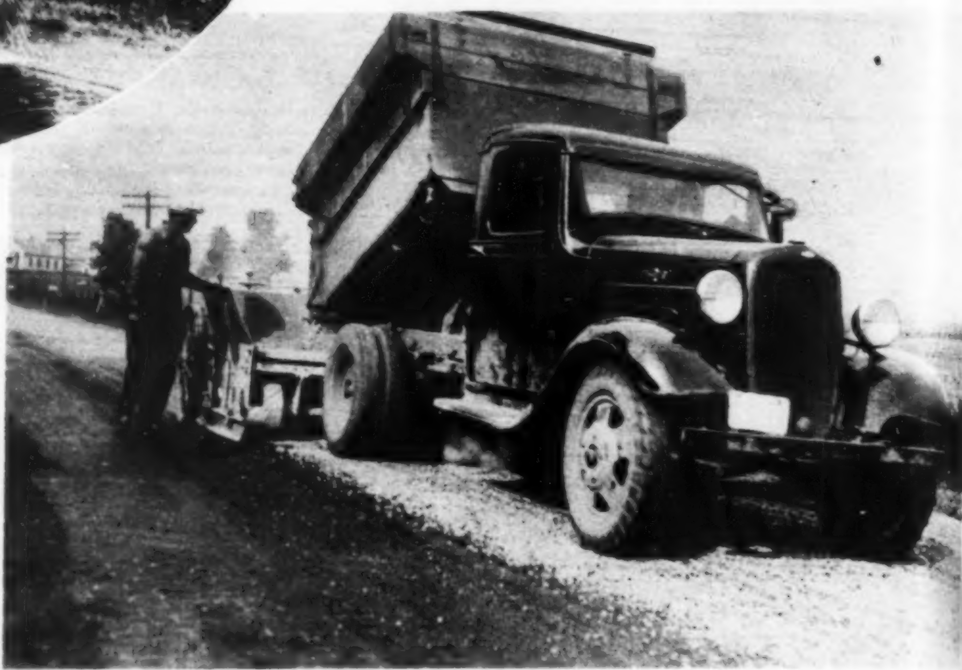
Step-by-Step Field Methods —

Traveling Machine Lays Mixed-in-Place Road Surface



UNDER A NEW specification calling for a rapid-curing cutback asphalt mix, the State Highway Department of Ohio, with the aid of a tractor-hauled mixing and spreading machine employing the principle of a triple pug-mill, has laid this year on two-lane secondary roads, usually 18 ft. wide, more than 100 mi. of mixed-in-place retread surfacing 1½ in. thick. Construction is carried on in half-widths of 9 ft. so that traffic need not be detoured around the section of highway on which resurfacing work is in progress. The accompanying illustrations show the equipment and the sequence of operations followed in placing this type of mixed-in-place surfacing.

1 **SPREADER BOX first distributes 10 lb. of stone per square yard over tack coat.**



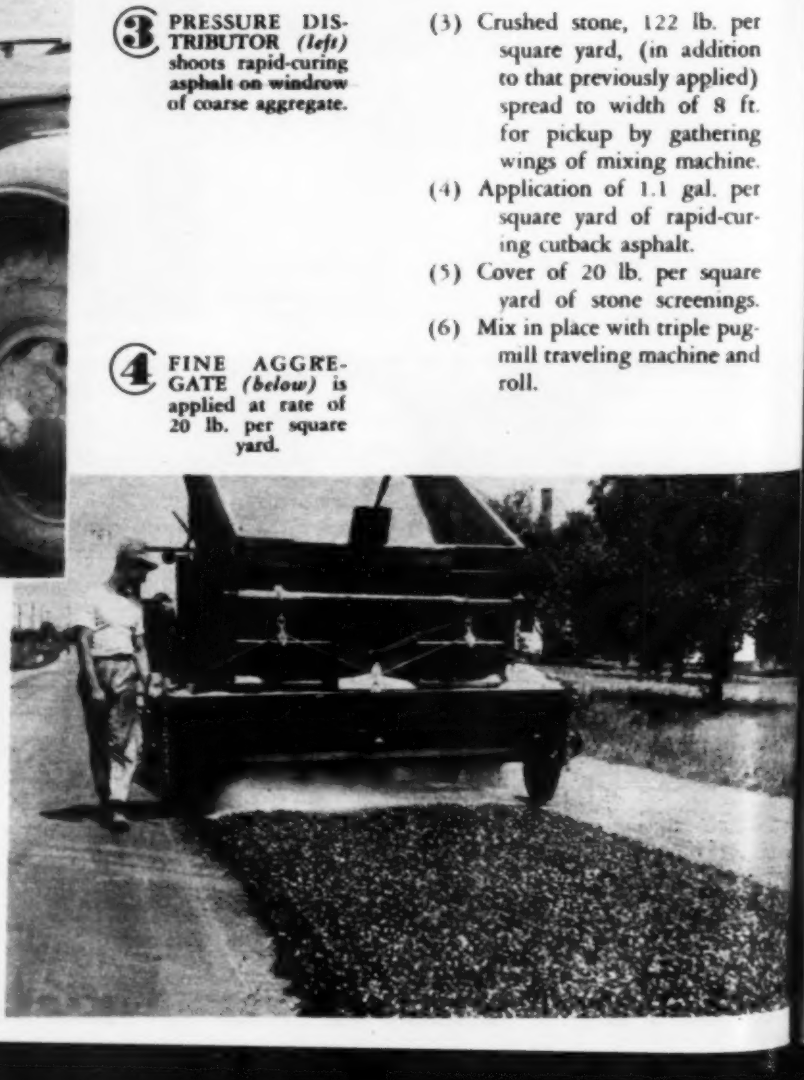
2 **STONE, in amount of 122 lb. per square yard *(right)*, is spread to width of 8 ft. on subgrade.**

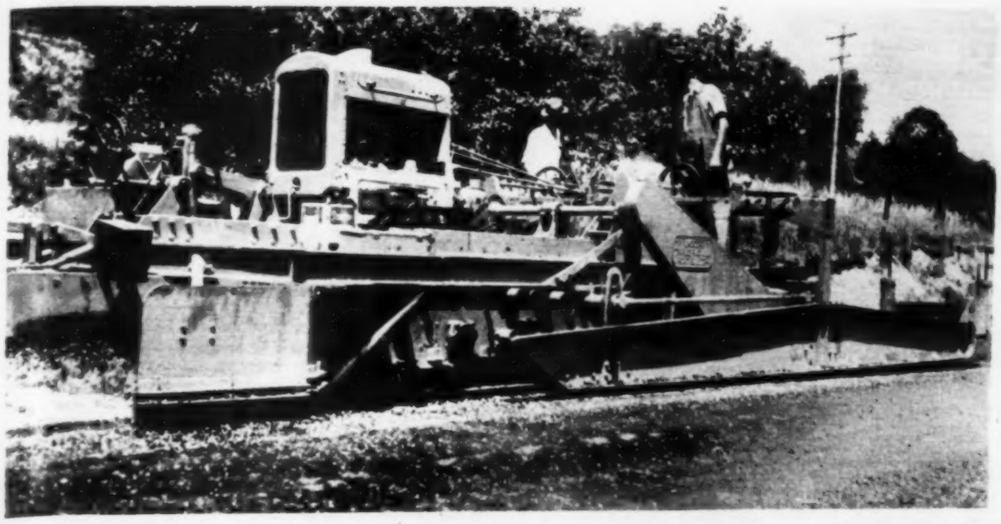
3 **PRESSURE DISTRIBUTOR *(left)* shoots rapid-curing asphalt on windrow of coarse aggregate.**

The coarse aggregate employed is crushed stone ranging in size from ¾ to ¼ in., with additions of screenings or sand to fill the voids and produce a dense mix. The specifications allow for the use of slag, gravel or crushed stone, in conjunction with slag screenings, sand or limestone screenings. Typical procedure and quantities on a crushed stone job, with stone weighing 2,400 lb. per cubic yard, are as follows:

(1) Tack coat, 0.1 gal. of asphalt per square yard.
(2) Crushed stone, 10 lb. per square yard to cover tack coat prior to spreading remainder of coarse aggregate.
(3) Crushed stone, 122 lb. per square yard, (in addition to that previously applied) spread to width of 8 ft. for pickup by gathering wings of mixing machine.
(4) Application of 1.1 gal. per square yard of rapid-curing cutback asphalt.
(5) Cover of 20 lb. per square yard of stone screenings.
(6) Mix in place with triple pug-mill traveling machine and roll.

4 **FINE AGGREGATE *(below)* is applied at rate of 20 lb. per square yard.**





5 **MIX-IN-PLACE MACHINE** *(left)*, showing gathering wings, at left, and 21-ft. long straight-edge runners carrying screed of finishing unit.

6 **REAR VIEW** *(below)* of traveling machine laying first 9 ft. lane of 18-ft. pavement.

(7) Apply seal coat of 0.25 gal. of asphalt per square yard and 15 lb. per square yard of screenings.

Bids on resurfacing of this type have ranged from about 35 to 40 c. per square yard. Crushed stone is distributed upon the subgrade to a width of 8 ft. by a spreader box on the rear end of a truck and is placed ahead of the mix-in-place machine in windrows from 1,000 to 2,000 ft. long.

The mix-in-place machine, a product of the Jaeger Machine Co., of Columbus, Ohio, consists of a mixing and a finishing unit, drawn by a tractor, and making only one pass over the windrowed material on the road. The mixing unit is mounted on three wheels and consists of a steel frame equipped on the front end with gathering wings at each side and a V-nosed plow at the center which divides the windrowed material spread along the subgrade into two streams which move out toward the sides as the machine travels forward. The material is deflected by baffle plates back toward the center of the machine where the revolving blades of three separate pug-mill elements mounted on horizontal shafts produce a thorough mixing of the bituminous material and stone aggregates in place on the road. Controllable gates behind the second pug-mill element enable the operator to divert material to either side of the road, as desired.

The finishing unit, behind the triple pug-mill, consists of an adjustable screed strike-off centered on 21-ft. long steel shod straight-edge runners, one on each side, which serve as movable forms, producing a square-edge along the bituminous mix for a perfect butt joint with the adjoining paved lane of the road. All operations of both mixer and finisher are in full view of one operator who controls both units from a platform at the rear of the screed.

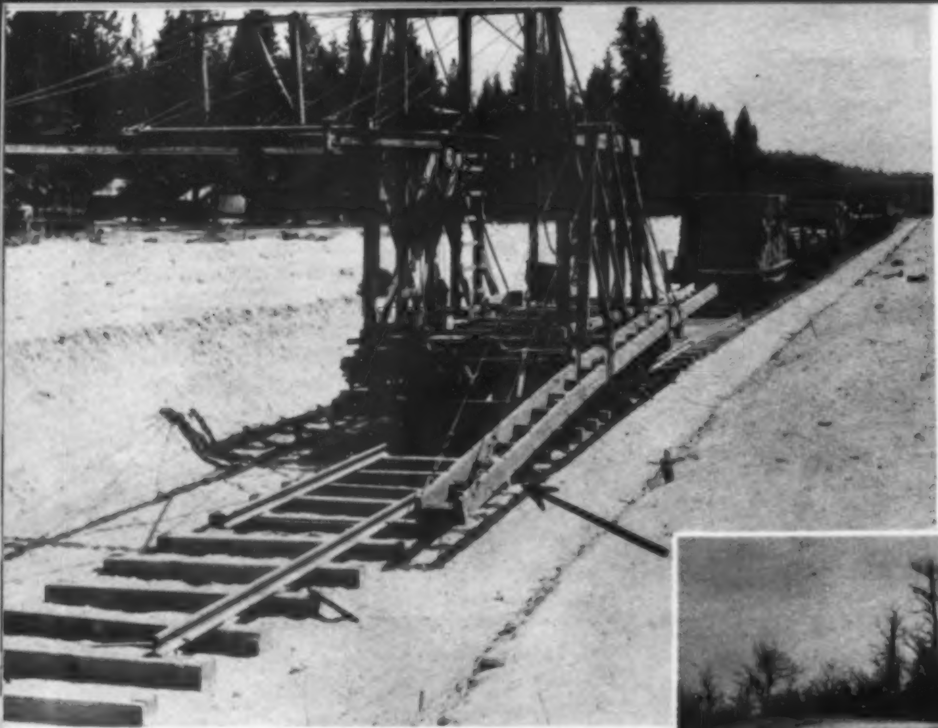
The mix-in-place machine has a capacity of handling windrowed material spread in amounts up to 2 cu. ft. per linear foot of windrow. On the Ohio work the material to be mixed in place ran about 1 2/3 cu. ft. per linear foot of roadway lane. The operating speed of the tractor hauling the machine is limited to 80 ft. per minute and is usually fixed at from 60 to 70 ft. per minute, to give more mixing time. A single 80-hp. tractor has handled these operations but in many cases two 60-hp. units or a 60- and a 40-hp. unit in tandem are used to insure ample tractive power at the low speeds which produce most thorough mixing.

7 **BEFORE ROLLING** *(left)*. Note straight edges of half-width pavement mixed and laid by machine.

COMPACTING of retread mix to thickness of 1½ in. is done by rolling, after which road may immediately be opened to traffic.

Getting Down to

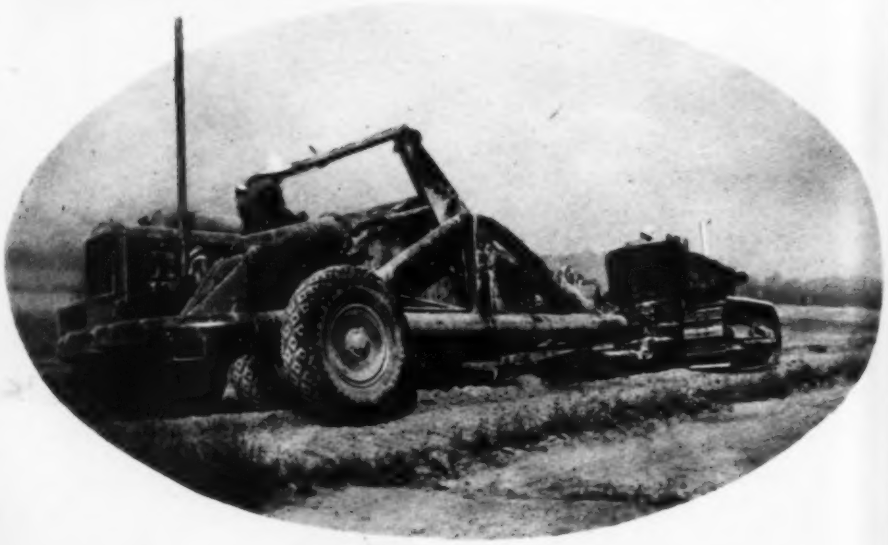
DETAILS



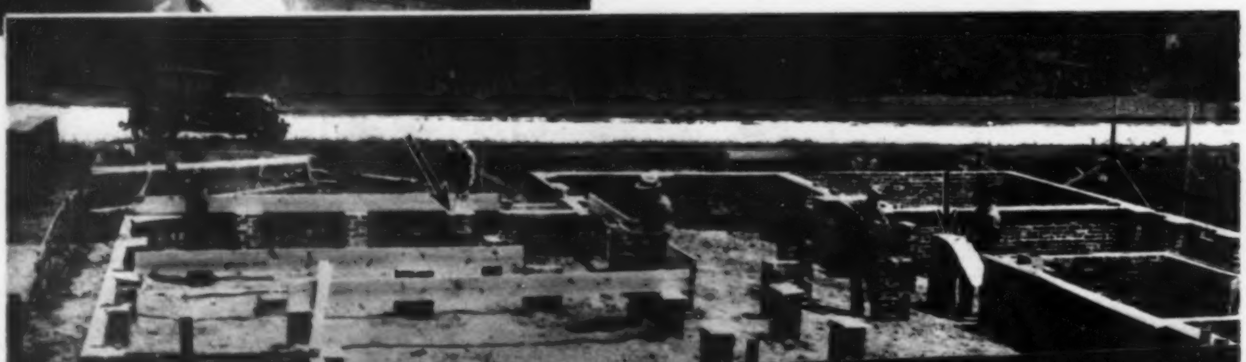
FOR LAYING RAILROAD TRACK *(above)* Southern Pacific Co. uses this mobile machine served by material train in rear. At side is conveyor for delivering ties. Twin booms overhead handle rails to place.

TO HOLD ROAD DRAG *(right)* of sled type on proper line and prevent "slewing" along superelevated curves of Skyline Drive in Virginia, old front end from 1920 Autocar was coupled to Galion road patrol and steered by operator in manner of fire department hook-and-ladder truck. Crossed chains between steering trailer and road drag held drag accurately along correct travel route. —*Photo from* G. Y. CARPENTER, *Luray, Va.*

MOTOR-DRIVEN HOIST *(above)* handles segments of heavy cast-iron rings used by Mason & Hanger Co., Inc., for lining 31-ft. diameter Midtown Hudson tunnel, nearly completed subaqueous vehicular route between New York and New Jersey. Lo-Hed unit is mounted on wheels running on lower flanges of I-beam track.

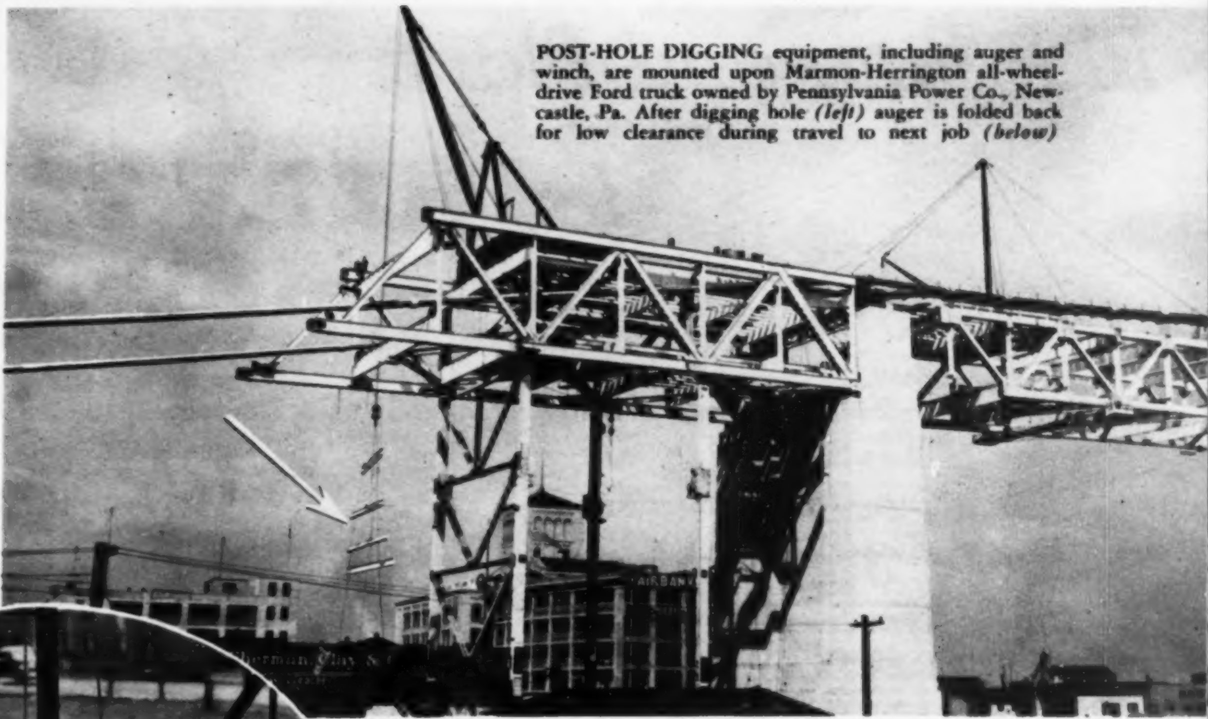


ELEVATED AIR INTAKE *(above)* in form of vertical 2-in. pipe 15 ft. long, is guyed by three wires to frame of Patterson scoop to avoid dust during highway grading in Indiana on contract of T. H. McAfee and J. C. O'Connor. — *Photo from* GLEN F. SCRIVNOR, *Crown Point, Ind.*



PROTECTION FROM TERMITES on new building of Junior Chamber of Commerce in Birmingham, Ala. is afforded by placing metal shields between foundation masonry and structural timber. Shields are bent down at angle of 45 deg. and extend 2 in. beyond masonry to prevent termites from extending tubes to wood sills.

Close-Up Shots of Job Methods and Equipment



POST-HOLE DIGGING equipment, including auger and winch, are mounted upon Marmon-Herrington all-wheel-drive Ford truck owned by Pennsylvania Power Co., Newcastle, Pa. After digging hole *(left)* auger is folded back for low clearance during travel to next job *(below)*

MULTIPLE HOISTING of steel members is feature of erection of continuous spans of East Bay crossing of San Francisco-Oakland Bay bridge. Four steel members are being raised simultaneously to place by traveling stiffleg derrick.

FOR PATCHING CONCRETE SURFACES, *(below)* filling bolt holes or smoothing gravel pockets, this grout ejector, small enough for one man to carry as he walks along, has been developed by L. E. McCormick, foreman for Broderick & Gordon, contractors on Colorado River aqueduct in California. Grout hopper, containing 1:3 cement-sand mix, is fitted with air connection and nozzle controlled by valve. Air at 40- to 50-lb. pressure is supplied by ½-in. hose.

WANTED —
Photos of Details

The Editor of Construction Methods wants photographs or sketches illustrating interesting **DETAILS** of method or equipment and will pay for those he finds acceptable for publication.

Hasn't your job produced some **DETAIL** that might be illustrated on this page? Send along a picture of it; we'll return it promptly if we can't use it.

FOR HIGHWAY SURVEYS *(below and right)* this 2-ton truck with screened sides has been specially equipped by District 9 of California Division of Highways. It accommodates party of five men and their equipment. Two transits and level are supported by coiled springs and protected against jar by heavy felt strips. Boxes on false top contain level rods and range poles. Screened compartment contains seat with space for extra clothing. — *Photo from* MILTON HARRIS, *Acting District Locating Engineer, Bishop, Calif.*

Planning and Plant for HEAVY CONSTRUCTION

ELEVENTH OF A SERIES OF ARTICLES

Principles and Practices of Job Layout and Selection and Use of Equipment for Large Dams and Appurtenant Works

By ADOLPH J. ACKERMAN and CHARLES H. LOCHER
Construction Plant Engineer — *Construction Consultant*
TENNESSEE-VALLEY AUTHORITY, KNOXVILLE, TENN.

11 . . . Pile Driving and Extracting Unwatering Cofferdams

AMERICAN SHEETPILING has recently become standardized with respect to the design of interlocks so that the differences are only minor, as indicated in Figure 1. It is possible to interlock the sheetpiling of different makes, but this is not advocated where the stress is likely to be high, because a combination of different interlocks may develop eccentricities which might overstress one or the other.

For cellular cofferdams where the piling is in heavy tension through the interlock a straight-webbed piling is generally employed, and special T's and Y's are fabricated for the junctures. The piling usually has two handling holes at the top which are later used for extracting. Important economies can be developed by properly arranging with the fabricator to schedule his shipments so that the piling can be handled almost directly from cars into the work. It is a great advantage to have the length of piling marked at the rolling mills, either by stencils or dies, to facilitate handling in the field.

Pile Drivers — The best manner of handling sheetpiling for driving into cofferdams or other structures depends largely on local conditions and the availability of equipment which may be suited to other services after the driving is completed. With certain hammers, and where the piling is exceptionally long, say greater than 60 ft., or the penetration is difficult, it is customary to handle it in special leads where it may be braced against lateral deflections. In the construction of cofferdams it has become quite common to dispense with leads and use a suitable yoke or guiding fins (Fig. 2) on the bottom of the pile hammer so that it can rest directly on the pile and keep the hammer in a vertical position.

Fig. 2 . . . SPECIAL SIDE FINS guide pile hammer. Man suspended by crane is safer than when sitting on piling where swinging hammer might knock him off.

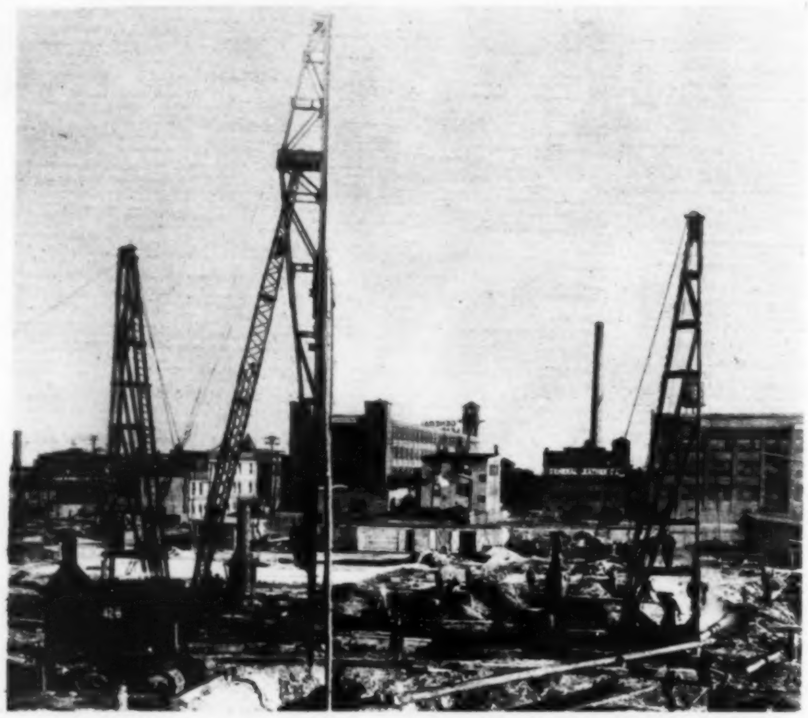


Fig. 3 . . . TWO TYPES of piledriving leads. In foreground, swinging leads mounted on crawler crane; in background, fixed leads on skids with steam hoist.

Fig. 3 shows two common types of leads. They are sufficiently long so the longest piece of piling may be readily handled and passed over obstructions, and with sufficient space to spare at the top to accommodate the hammer and rigging. The hoisting equipment on piledrivers, which is generally steam operated to serve also the hammers and later the extractors, usually requires oversized boilers because of the great amount of steam which is sometimes needed during difficult extracting.

At Pickwick Landing Dam, as described in a previous chapter, the pile-handling equipment consisted of special skid-guy derricks, which normally operated on land but were mounted on barges and floated for the construction of the cellular cofferdams. Special attention must be given to the mobility of the equipment in shifting or booming from pile to pile, as a great amount of time may be lost by cumbersome equipment.

Pile Hammers — The best known American pile hammers are shown in Fig. 4 and their characteristics for the heavy duty sizes are given in the accompanying tables. The selection of a pile hammer should take account of the following fundamental considerations:

> 1. The ram must be of the proper weight in relationship to the weight of the pile and the resistance to penetration.
>
> 2. The velocity of the ram at the instant of striking should be low. A transfer of energy at low velocity moves the pile farther.

If the ram is too light it will rebound and barely overcome the inertia of the pile. If the ram is too heavy it may bend or otherwise damage the pile. If the velocity is high, rebound and battering of the top will develop. The efficiency of transferring energy

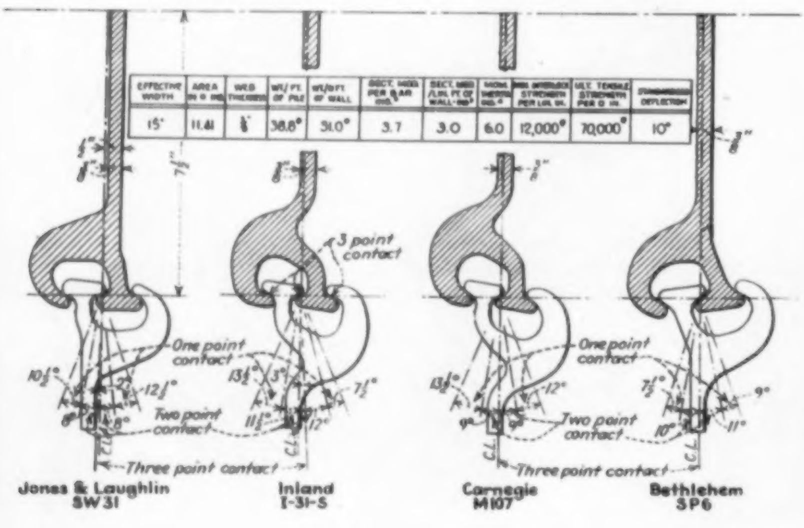


Fig. 1 . . . COMPARISON OF INTERLOCKS on four standard makes of American sheetpiling.

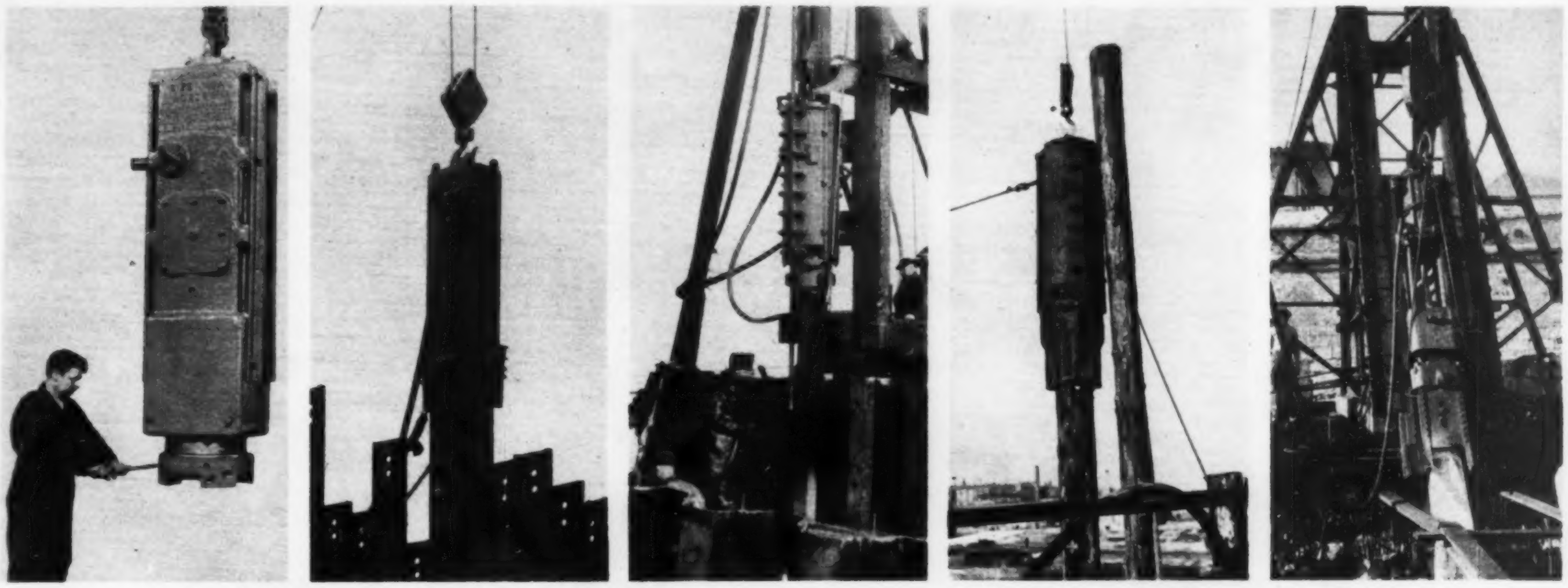


Fig. 4 . . . STANDARD MAKES of American pile hammers. This group shows, (left to right): (1) Union pile hammer of double-acting type; (2) McKiernan-Terry pile hammer of double-acting type; (3) Vulcan double-acting pile hammer with swiveling type of anvil; (4) Vulcan double-acting pile hammer with special sleeve type base; (5) Vulcan single-acting hammer mounted on inclined leads.

from hammer to pile in such cases is low.

The energy developed by a pile hammer, in foot-pounds, is the product of the weight of the ram, (plus the equivalent of the pressure applied by the steam) and the distance through which the ram travels. A light ram may develop the same energy in dropping through a great distance as is developed by a heavy ram dropping through a short distance. However, at the end of the stroke there is a great difference in velocity. In recent years practically all manufacturers have adopted relatively heavy hammers striking at low velocities.

In the single-acting pile hammer the ram is raised by steam and then drops freely under its own weight. This type of hammer, as a rule, requires special leads to guide it and special accessory bases to adapt it to different kinds of piling. In the double-acting hammer the steam is applied at the top of the ram as well, and helps to drive the ram down. The main advantages of the double-acting hammer are: The greater number of blows struck per minute, which generally cuts the driving time in half, and the ability to dispense with special leads. The fast blows result not only in faster driving and greater penetration but less damage to the piling due to practically continued vibration going through the pile, eliminating a great deal of the skin friction which quickly develops in the soil where there is a period of rest between blows.*

The modern double-acting pile hammers are fully inclosed, which is important in the prevention of accidents to operators and also in keeping foreign substance from getting into the working parts of the hammer. It is possible to employ them for subaqueous driving and allow the hammer to follow the piling down into the water, which, in some cases, has been to a distance of 80 ft. This is accomplished by admitting air at a pressure slightly in excess of the water pressure to the ram cylinder to keep out the water, and conducting the exhaust to the surface.

All pile hammers are designed for operation either by steam or air at a pressure of 80 to 100 lb. per square inch.

Rules for Pile Driving—One of the most important rules in the driving of sheetpiling is to *drive truly vertical,* keeping the hammer as vertical as pos-

DATA ON PILE HAMMERS . . . HEAVY-DUTY TYPE

MAKE AND TYPE	MODEL	WEIGHT, Lb. Complete Unit	WEIGHT, Lb. Ram	STROKES No. Per Min.	STROKES Length In.	ENERGY delivered in foot-lb. Per Blow	POWER REQ'D Steam B.H.P.	POWER REQ'D Com. Air Cu. Ft. Free Air Per Min.	EQUIVALENT FALL Ft.
								100Lb.	
McKiernan-Terry DOUBLE-ACTING	9B3	7000	1600	145	17	8750	45	600	5.5
	10B3	10850	3000	105	19	13100	50	750	4.4
	11B3	14000	5000	95	19	19150	60	900	3.8
								100Lb.	
Union DOUBLE-ACTING	1½A	9200	1500	135	18	8280	35	450	5.5
	1 A	10500	1600	130	18	10020	40	500	6.3
	1	10000	1600	125	21	12725	40	600	7.9
	0	14500	3000	110	24	19850	50	750	6.6
	0 A	15000	5000	95	21	22050	60	800	4.4
	0 O	21000	6000	85	36	54900	125		9.1
								100Lb.	
Vulcan DOUBLE-ACTING	3000	1250	3000	133	12½	7260	40	488	2.4
	5000	12140	5000	120	15½	15100	60	880	3.0
	8000	18480	8000	111	16½	24450	80	1245	3.0
	14000	27980	14000	103	15½	36000	100	1425	2.6
	20000	39050	20000	98	15½	50200	120	1745	2.5
								80Lb.	
Vulcan SINGLE-ACTING	2	6700	3000	70	29	7260	25	580	2.4
	1	9600	5000	60	36	15000	40	975	3.0
	0	16250	7500	50	39	24375	60	1450	3.25

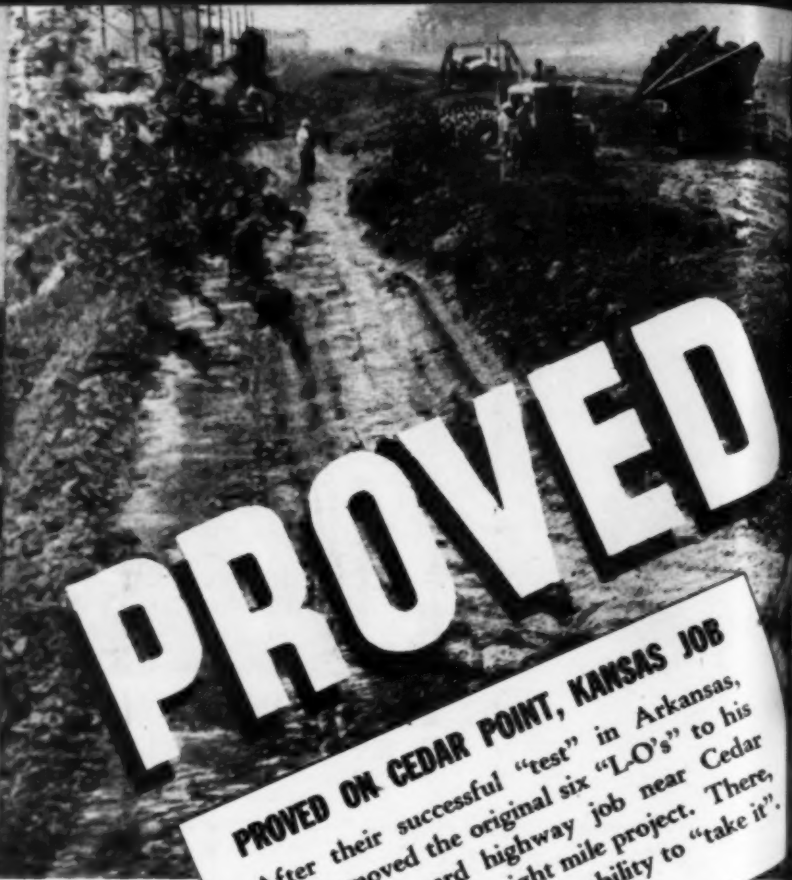
SIZES AND CAPACITIES of standard heavy-duty pile hammers and extractors.

DATA ON PILE EXTRACTORS

MAKE	MODEL	WEIGHT, Lb. of Unit Complete Lb.	WEIGHT, Lb. of Ram Lb.	STROKE No. Per Min.	STROKE Length Inches	ENERGY Of Blow Ft.-Lb. Per Blow	POWER REQ'D Steam B.H.P.	POWER REQ'D Comp. Air- Cu. Ft. Free Air Per Min.	POWER REQ'D Comp. Air- Pressure Delivery Lb. Per Sq. In.	MAX. CRANE PULL Tons
VULCAN	200	1500	200	550	2	250	18	312	150	25
	400	2850	400	550	2	500	25	615	150	25
	800	5400	800	550	2	1000	40	1330	150	25
McKIERNAN-TERRY	E 2	2600	200	450	3	700	30	400	100–125	50
	E 4	4400	400	400	3	1000	35	450	100–125	100
UNION	5	1625	210	190	9	910	10	100	100	
	4	2800	370	120	12	1390	12	150	100	
	3	4700	700	120	14	1780	20	300	100	
	3A	5200	820	120	13½	2320	25	350	100	
	2	6600	1025	115	16	2375	25	400	100	
	1½A	9200	1500	100	18	2500	35	450	100	
	1A	10,500	1600	95	18	3520	40	500	100	
	1	10,000	1600	95	21	4080	40	600	100	
	0	14,500	3000	80	24	3930	50	750	100	

TESTED ON FT. SMITH WATER SUPPLY JOB

"If the 'L-O' is as good as your Model 'L', it will do." M. E. Gillioz "tried out" his first six Oil Tractors near Mountainberg, Ark., (of Bob Burns fame) building a water supply dam for Fort Smith, 30 miles away.



PROVED ON CEDAR POINT, KANSAS JOB

After their successful "test" in Arkansas, Gillioz moved the original six "L-O's" to his half-million yard highway job near Cedar Point, Kansas—an eight mile project. There, they further proved their ability to "take it".

FIRST .. 6 OIL TRACTORS ... THEN

8 more FOR GILLIOZ

IN THE VERY HEART of the great Skyline Highway job . . . M. E. Gillioz of Monett, Mo., is carving 17 miles of scenic highway out of steep, rocky mountainsides. A big contract . . . involving 1,000,000 cubic yards . . . but all in the day's work to Gillioz. For dependable performance that would assure getting the work done on schedule . . . this successful contractor selected Allis-Chalmers Controlled Ignition Oil Tractors. Besides Diesel fuel oil economy, A-C Oil Tractors have such advantages as smoothness, balance and instant starting, made possible by controlled spark ignition. No wonder Oil Tractor owners repeat!

ALLIS-CHALMERS *Controlled Ignition* **OIL TR**

TRACTOR DIVISION—MILWAUKEE, U. S. A.


APPROVED!
8 MORE ORDERED FOR THE SKYLINE JOB
Awarded 17 miles of the famous Skyline Highway in Virginia's Blue Ridge Mountains, Gillioz relied on the tractor that had proved itself on previous jobs — ordered eight more Model "L-O" Oil Tractors. Shown here are "L-O's" with bulldozer and 12-yard A-G wagons, working on the million yard contract.
L TRACTORS

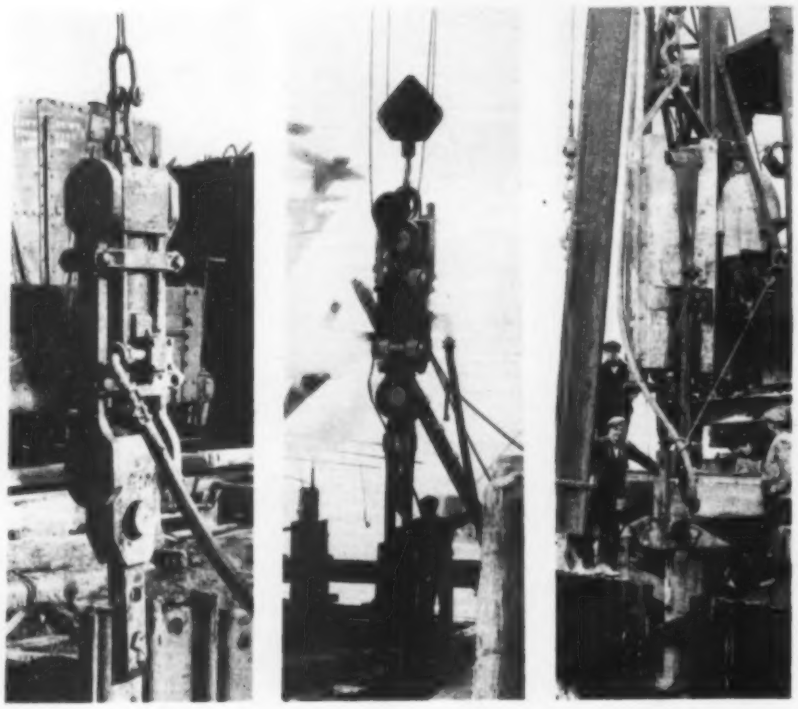


Fig. 5 . . . GROUP OF PILE EXTRACTORS, showing, left to right: (1) McKiernan-Terry extractor; (2) Vulcan extractor; (3) Union pile hammer, inverted and used as extractor.

sible and driving slowly and gradually. Another important point is the simple expedient, which is not practiced nearly as much on construction jobs as it ought to be, of placing a small plug on the underside of the open interlock, so that as the pile is driven down, the plug prevents earth from being driven into the exposed interlock. This helps to keep the interlock clean and facilitates driving of the next pile and is particularly useful in reducing the energy required for later extracting the piling.

In the construction of cellular steel cofferdams it is important to provide adequate guide templets to hold the empty cells in place and truly vertical during assembly and driving. Frequently such templets consist of previously driven round timber piling, heavily braced, and provided with guide edges to which the piling may be assembled. The portable steel templet which was developed at Pickwick Landing dam, as described in an earlier chapter, has proved particularly successful in displacing the necessity of building up timber structures, the entire templet being lifted out of the completed cell and set forward for assembly of the next cell.

If the hammer is too large and drives too hard, the bottom of the piling may be readily deflected out of its straight course by a large boulder or other obstruction, and in that case the pile may readily jump out of the interlock and thereby destroy the effectiveness of the sheetpile structure. Fig. 6 shows typical cases of piling which had to be uncovered after it was driven, because of the excessive leakage which developed. The severe driving is quite apparent, in one case causing the pile to curl up and in other cases to jump the interlock. The bruised condition of this piling is striking and significant, particularly when it is considered that it had to be pulled for later redriving. It is easy to understand that tremendous pulling forces must be applied to first of all straighten the piling at least in a general way so that it can retrace its path upward.

Pile Extractors—The smaller sizes of McKiernan-Terry hammers may be inverted and used in driving out sheetpiling. However, the heavy-duty hammers are not suitable for this purpose and the makers offer a special type of extractor. Such extractors are shown in Fig. 5. The Vulcan extractor is similar to the McKiernan-Terry in general characteristics, while Union employs the principle of inverting its heavy-duty hammers for this service. The specially designed pile extractor is very much lighter and shorter than an inverted hammer. Its lower weight and universal yoke at the bottom facilitate handling the extractor and laying down the pile with a minimum amount of hand labor. The extractor does not really do the extracting, but its sharp, quick blows set up vibration in the piling, breaking the skin friction and interlock friction so that the hoisting apparatus on the extractor can withdraw the loosened pile.

It is rather strange to find that no modern extractor is designed to withstand more than approximately 100 tons of pull at its upper end. In fact, some of them can withstand only a fraction of such a pull. It has been repeatedly found necessary to employ heavy pulling rigs which are capable of developing between 100 and 200 tons in order to loosen the piling, particularly if it has been in the ground for a great length of time, and this requires special rigging independent of the extractor. Another strange thing

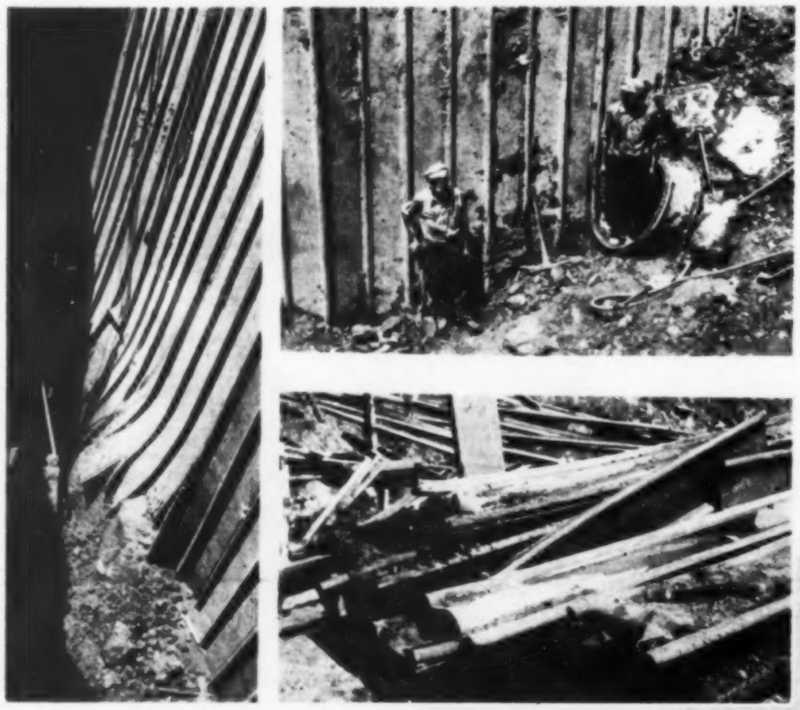


Fig. 6 . . . PILING DEFORMED during driving, indicating difficulties which must be considered in planning for extracting piling.

Fig. 8 . . . SKID GUY DERRICK, used in combination with pile extractor to remove sheetpiling, and special A-frame with heavy-duty blocks designed to apply pull of 150 tons to start piling at beginning of pull.

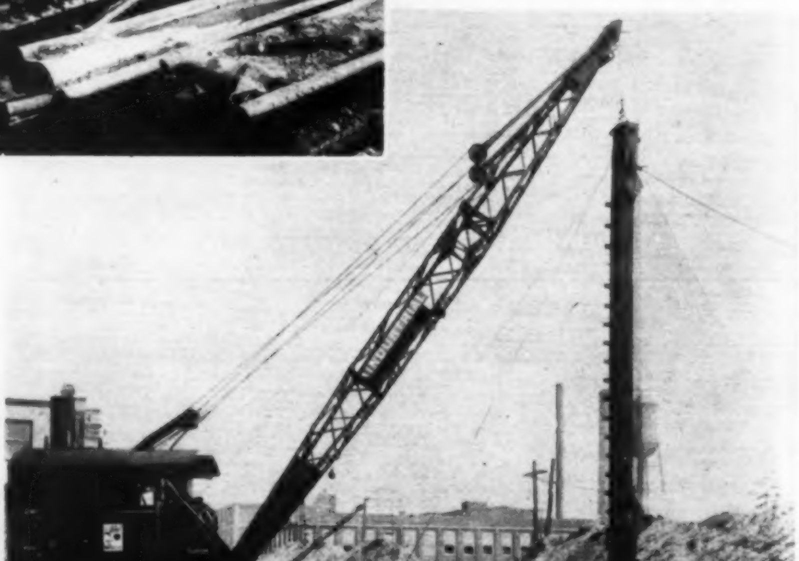


Fig. 7 . . . EXTRACTING SHEETPILING with heavy block and tackle operated by locomotive crane and using heavy timber mast resting on adjacent sheetpiling.

Fig. 9 . . . STEEL A-FRAME, capacity 100 tons, used to apply heavy pull in starting extracting of piling in combination with standard extractors operated from skid guy derrick.

is that most extractors are furnished with special bars for making a relatively loose connection to the piling, which is entirely inadequate where the pulling is difficult. Such bars should be clamped tightly to the piling so as to develop, in addition to bearing in the hole, a very substantial amount of friction on the sides. If the bars are connected loosely to the piling the impact from the extractor will cause the holes to rip and the metal to roll upward without actually moving the pile.

Cofferdam Removal and Extracting of Piling—As a general thing insufficient consideration is given to the removal of cofferdams. The dismantling of rock-filled cribs of certain designs, for example, is frequently difficult and not suited to equipment operation. The same criticism may be leveled against the extracting of sheetpiling. Generally, an attempt is made to drive the piling down so as to insure a tight bottom and a minimum amount of leakage, whereas a reasonable leakage and greater pumping may be far more economical in the long run, because of the saving made in extracting the piling under more favorable conditions if it is not damaged either at the top or bottom.

Where the piling has been driven with reasonable care it is generally feasible to extract it with a pull of approximately 25 tons applied at the top of a standard extractor. Sometimes the same results may be obtained without an extractor by applying a force of 25 to 50 tons to the piling by means of a special rigging such as the one shown in Fig. 7, which consists of a simple mast resting on the adjacent pile, and supported laterally by simple guy cables and attachment to the crane boom at the top.

Most of the extracting effort must be applied at the start in loosening the piling, especially if it has been in the ground a long time. Fig. 8 shows an arrangement employed at Madden dam, consisting of a standard skid-guy derrick operating in combination with a special A-frame mast from which was suspended a 16-part set of fall blocks. This unit was designed for a pulling effort of 150 tons. After the piling had come up 15 or 20 ft., it was sufficiently loose to permit the extractor to continue without assistance from the A-frame, and the hook on the heavy-duty block was made to drop out and the extractor to continue, without stopping to disconnect the two systems.

Fig. 11 . . . HEAVY-DUTY EXTRACTOR mounted on barge and designed to develop a pull of 300 tons.

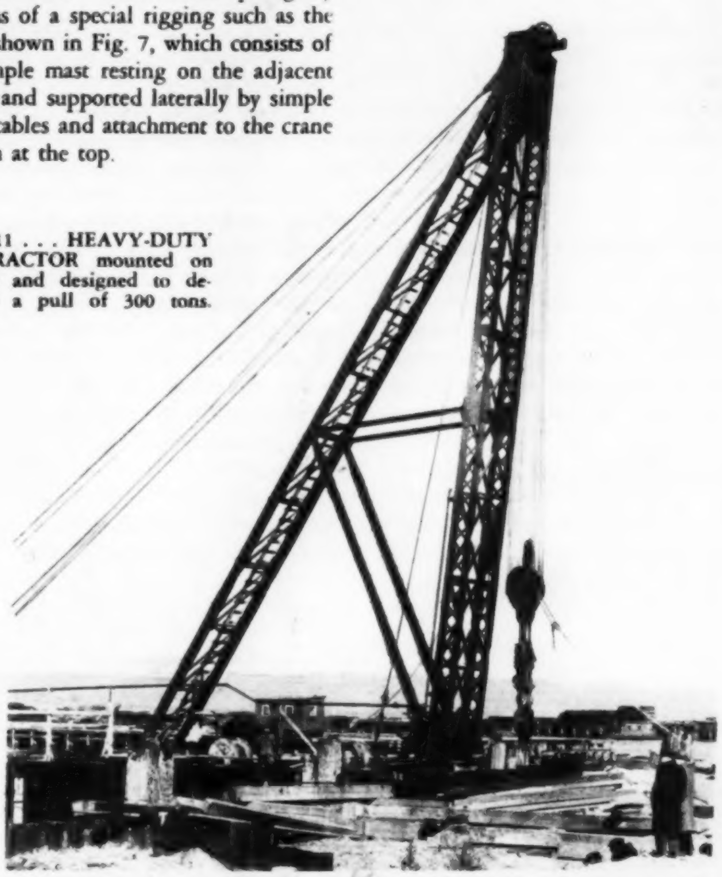


Fig. 10 . . . STANDARD EXTRACTORS used in combination with special A-frame and 150-ton blocks at beginning of pulling operation.

The timber A-frame shown in this illustration proved particularly successful, because it permitted a great amount of deflection to occur to indicate the amount of pull being applied.

A steel unit was also employed on the same job, as shown in Fig. 9. This was designed for a capacity of 100 tons and equipped with a special hook and a triangular yoke to which the pile and the extractor were connected. It should be noted that this triangular yoke was not very satisfactory because the main pull was applied through the block and the extractor was at one side where its impact caused a certain amount of rotation of the yoke, rather than a direct delivery of impact to the pile. This was overcome by the type of yoke shown in Fig. 10. Here the main pull as well as

SELECTION of PILE HAMMERS . . . For various types of piling and for average and hard driving

RECOMMENDED SIZE OF HAMMER, AS MEASURED BY ENERGY OF BLOW IN FOOT POUNDS (*Manufacturers' Recommendations*)

LENGTH OF PILE FEET	DEPTH OF PENETRATION PER CENT	SHEET PILE* LIGHT	SHEET PILE* MEDIUM	SHEET PILE* HEAVY	TIMBER PILE LIGHT	TIMBER PILE HEAVY	CONCRETE PILE LIGHT	CONCRETE PILE HEAVY
	WEIGHT IN POUNDS PER LINEAR FOOT OF PILING	20	30	40	30	60	150	400
TABLE A . . . DRIVING THROUGH EARTH, SAND, LOOSE GRAVEL. . . . NORMAL FRICTIONAL RESISTANCE								
25	50	1000–1800	1000–1800	1800–2500	3600–4200	3600–7250	7250–8750	8750–15000
	100	1000–3600	1800–3600	1800–3600	3600–7250	3600–8750	7250–8750	13000–15000
50	50	1800–3600	1800–3600	3600–4200	3600–8750	7250–8750	8750–15000	13000–25000
	100	3600–4200	3600–4200	3600–7500	7250–8750	7250–15000	13000–15000	15000–25000
75	50		3600–7500	3600–8750		13000–15000		19000–36000
	100			3600–8750		15000–19000		19000–36000
TABLE B . . . DRIVING THROUGH STIFF CLAY, COMPACTED GRAVEL. . . . VERY RESISTANT								
25	50	1800–2500	1800–2500	1800–4200	7250–8750	7250–8750	7250–8750	8750–15000
	100	1800–3600	1800–3600	1800–4200	7250–8750	7250–8750	7250–15000	13000–15000
50	50	1800–4200	3600–4200	3600–8750	7250–15000	7250–15000	13000–15000	13000–25000
	100		3600–8750	3600–13000		13000–15000		19000–36000
75	50		3600–8750	3600–13000		13000–15000		19000–36000
	100			7500–19000		15000–25000		19000–36000

*Energy required in driving single sheet pile. Double these when driving two piles at a time.

Fig. 12 . . . COFFERDAM at Pickwick Landing, showing vertical centrifugal pumps (in center) and horizontal centrifugal pumps (at left) during unwatering of cofferdam after flooding.

Fig. 13 . . . VERTICAL TYPE centrifugal pumps with motor at top and impeller at pump inlet, especially designed for cofferdam service. Flexible hose permits lowering as water level drops.

Fig. 14 . . . SPECIAL UNWATERING PUMP, gasoline-engine-driven, with impeller mounted on extended shafts at intake end of struction line.

the impact developed by the extractor were applied axially with respect to the piling. To accomplish this arrangement it was necessary to replace the usual type of I-bars found on standard extractors with new ones which extended above the extractor to permit connection to the heavy-duty block. However, the nature of the extractor design was such as to require a pull to be applied to the top of the extractor itself, and for this purpose a second line from the derrick maintained a constant tension at this point. This arrangement proved particularly effective in extracting difficult piling.

One of the most difficult extracting jobs occurred in the construction of some large piers for the City of New York where it was necessary to remove piling varying in length from 46 to 96 ft. The pulling rig employed on this job is shown in Fig. 11. It consisted of a 70-ft. steel frame, equipped with a head-piece and fall block all containing roller bearing sheaves and reeved with 19 parts of cable. The hoist cable was rigged to a 9x10-in. double-cylinder steam engine and in this manner was capable of developing a pull of 300 tons. In addition to this, a line was attached to a Vulcan pile extractor which developed the necessary vibration to shake the piling loose. Some of the piling required a pull of 225 tons.

In the pulling of sheetpiling, where the interlock friction is high, it is extremely important to observe the possibility of developing elongation of the interlocked edge of the pile as it is coming up, and curvature in its own plane, thus making it practically useless for further use. The customary procedure in such cases is to step ahead a few piles and try to pull one of the sheets back in the line where the resistance is uniform on both edges, and then step back to pull the other piling.

UNWATERING COFFERDAMS

Cofferdam Unwatering Pumps—The common remark, "a pump's a pump," is not correct when it comes to the selection of pumps for unwatering service around cofferdams or other construction work. Some pump builders have studied cofferdam pumping and have acquired considerable experience through constant check of performance of their equipment in the field. A pump specially designed for such service may cost somewhat more than an ordinary pump, but the saving in shutdowns may readily amount to more than the first cost of the pump.

Cofferdam pumping represents a variety of problems due to the presence of foreign materials such as sand, small stones, pieces of board, shavings, etc., and the ordinary pump, designed for handling clear water, has little usefulness around the cofferdam because of the fine clearances and practically no compensation for wear or means for quick replacement of parts. Furthermore, the type of metals employed in its construction is often entirely unsuited to the demands placed upon equipment in construction service. The importance of pumping is thoroughly demonstrated by such experiences as at Bonneville dam, where the power cost alone is said to have amounted to $50,000 over a period of 10 months.

Selection of Pumps—A proper installation of pumps for a cofferdam depends on judgment as to the expected leakage or inflow, as well as to the total volume within the cofferdam area, when the speed of pumping out after flooding is of considerable importance. It is not easy to predict such needs, but the most important principle to keep in mind is to provide ample capacity, because when the cofferdam is ready to be unwatered there is generally much money tied up, overhead expenses are high and any delays in getting under way are costly. The first requirements of cofferdam pumps (Figs. 12, 13 and 14) are ruggedness, reliability of service, and mobility. Efficiency is important, but secondary to these points. The pump sizes most

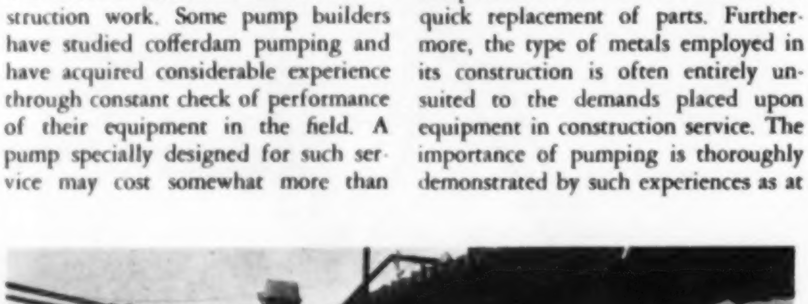


Fig. 17 . . . TYPICAL INSTALLATION of wellpoints, showing main pipe headers leading to pump installed in box located in the background. These wellpoints are keeping the earth on the inside of a cofferdam in a dry and stable condition.

Fig. 15 . . . WELLPOINTS in typical installation in water-bearing soil.

Fig. 16 . . . POROUS SCREEN through which water is drawn into wellpoints.

commonly employed are 10, 12 and 14 in.

Sometimes it is advisable to select a combination of pumps, as, for example, low-head pumps to remove the bulk of the water after flooding, and high-head pumps to remove the leakage. Fig. 18 shows the characteristic curves for a typical pump designed especially for cofferdam service, and the flat "hp" curve is of particular importance because it shows that no matter what the head is, there is no danger of overloading the motor. Certain types of pumps have a horsepower curve like the dotted line, and, under such characteristics, operating under a low head to pump out a flooded cofferdam, would result in overloading the motor and burning it out, especially if it is an induction motor.

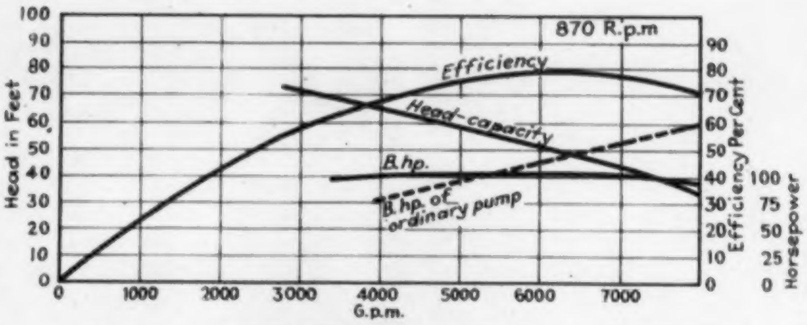


Fig. 18 . . . CHARACTERISTIC CURVES for centrifugal pump especially designed for cofferdam service. Note flat horsepower curve.

By selecting pumps designed for relatively low heads with the idea that they will operate at their maximum efficiency during unwatering service, as much as a day may be saved in pumping out a large cofferdam, and the same pumps will generally operate effectively in removing all the leakage at higher heads, after unwatering is completed, even though their efficiency is correspondingly less.

Because of the varying conditions of water level encountered in cofferdam service, the vertical type of pump is most adaptable because it can be used in places where it would be difficult to install horizontal units. Furthermore, the open-type impeller in a vertical pump prevents sand from locking the rotating parts, priming and foot valves are eliminated, and the general concentric construction allows it to be suspended on cables whereby it may be readily raised clear of the flood waters or lowered simply by adding short sections to the discharge line.

For removing water from minor areas within a cofferdam and running it to the main sump, smaller pumps, either electric or air-driven, are indispensable.

Method of Unwatering—When first pumping out a cofferdam, on earth foundations, it is particularly important carefully to check the rate of lowering the water level and to plot the information on a chart. This will disclose any startling developments, such as a blowout along the bottom, which may occur at times if the pumping is too fast and the equilibrium of the earth structure is disturbed too much.

Once the cofferdam has been pumped out, it is necessary to locate a permanent pump setting where a sump may be excavated down several feet so that all of the seepage water will run to this sump, and the suction ends of the pumps can be submerged in it to a sufficient depth to provide satisfactory pumping conditions. In this connection, an interesting experience occurred at Madden dam where the rock was overlaid with a very porous stratum of gravel, and large quantities of sand and small gravel were carried to the pumps. To simplify the pumping problem, a steel sheetpile cell was first driven to rock within the main cofferdam area, excavated on the inside, and properly braced, after which the excavation was carried about ten feet down into rock to provide a permanent sump. The pumps were placed in this sump and this resulted in a general lowering of the water table down to the rock level and greatly simplified control of the sand and small gravel.

Installation of Pumps—The arrangement of the discharge line deserves considerable study where the cost of power is a substantial item. For example, on one job, where from 30,000 to 50,000 gal. per minute were pumped under heads varying from zero to 85 ft., it proved economical to build a long double-deck flume from the pumps to a low point in the cofferdam in order to save, throughout the construction period, the power required to pump through an additional head of 10 ft. Similar economies can be obtained by increasing the pump capacity from 15 to 20 per cent by means of a siphon extending over the cofferdam down to the outer water level so as to reduce the net effective head on the pump. Contrary to usual conceptions, pump experts have found that the siphon will not break as long as the velocity in the discharge line in feet per second is greater than $5.5\sqrt{D}$, where D is the diameter of discharge pipe in feet.

On most modern jobs electric driven pumps are used, but in view of the great importance attached to maintaining a dry cofferdam it is highly desirable to have either a gasoline driven pump or generator set to supplement the main power supply in case of failure, which usually occurs during stormy weather when reliable unwatering service is most urgently needed. An important safety requirement to keep in mind for electric pumps is the use of low voltage motors and starting equipment, say 220 or 440 volts, because of the frequent servicing, shifting up or down, and general work required around them in wet weather.

Well Points—Fig. 15, 16, and 17 show typical features of a wellpoint system. Wellpoints have come into very common service on construction jobs with porous foundations for lowering the ground water below the working level so that all operations can be carried on in the dry. The wellpoints are generally 20 ft. long and equipped with nozzles, making it possible to apply pressure at the top to jet them down into the ground. The entire series of points is connected to a header line to the pump. The amount of water obtainable per wellpoint depends largely on conditions of the water-bearing stratum. In saturated sand sufficiently coarse to prevent movement and clogging of the screens on the wellpoint, it is claimed that 35 to 40 gal. per minute can be pumped per wellpoint, although this probably is the maximum. In fine sand the flow is considerably less; 28 gal. per minute is probably a high average.

The following information was obtained from an experiment conducted at Pickwick Landing dam where 47 wellpoints connected through an 8-in. header to a pump of 2,000 gal. per minute capacity were assembled below normal ground level in a water-bearing stratum of gravel. After each test a number of the wellpoints were shut off by means of special plug valves and the test was repeated. The following results were obtained:

Number of wellpoints	Total discharge, gallons per minute
47	290
36	290
30	284
22	258

This indicated that only half the wellpoints were necessary for the particular area to pump practically as much water as was brought forth in the full installation. Under the final conditions each wellpoint delivered approximately 10 gal. per minute.

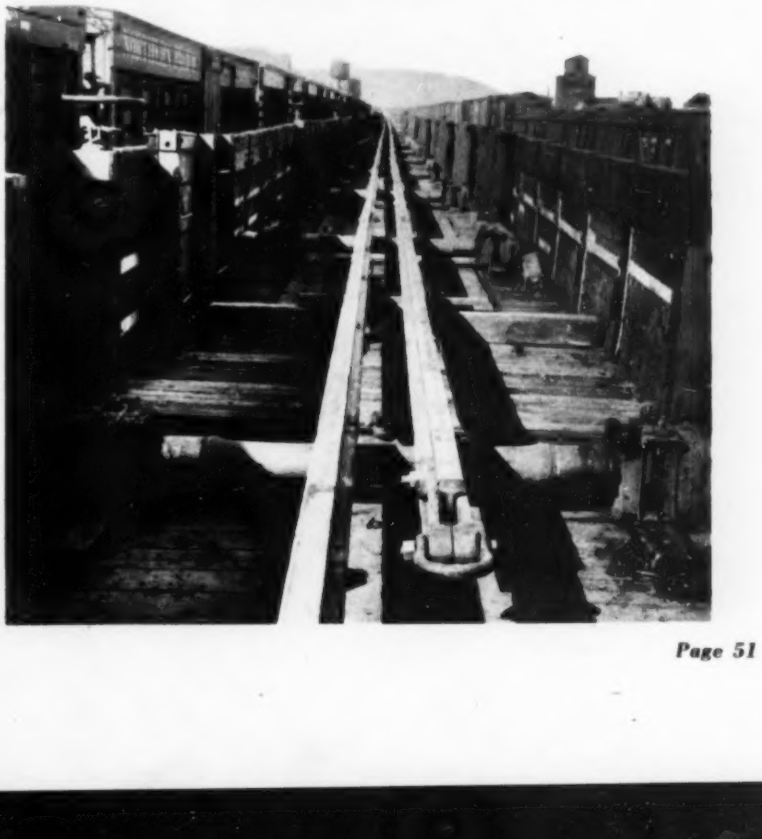
The average pump size for wellpoint service is approximately 1,300 gal. per minute.

◆

NEXT MONTH — Chapter 12 of the series on "Heavy Construction," by A. J. Ackerman and Charles H. Locher, to appear in the November issue will deal with "Excavating Equipment."

Longest Welded Rail

CONTINUOUS WELDED RAILS, 4,000 ft. long, the longest ever laid on a railroad system in one piece, are shown in the photograph below ready for laying in the Blossburg tunnel of the Northern Pacific Railway's main line through the summit of the Rockies just west of Helena, Mont. The rails in standard 39-ft. lengths weighing 131 lb. per yard, were welded together aboard 90 gondola cars from which the ends had been removed. Journals served as rollers underneath the continuous rails and facilitated unloading which is accomplished by parting the train in the middle and pulling half the cars at a time out from under the rails, permitting them to settle to the track. Each continuous rail weighed 85 tons. Similar continuous rails were laid recently in the 4,000-ft. Bozeman tunnel of the Northern Pacific between Livingston and Bozeman, Mont.



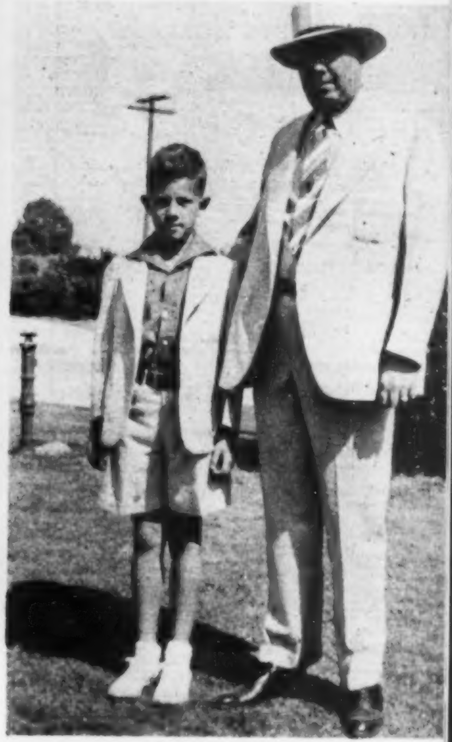
Digging Big Ditch

ON SECTION of 80-mi.-long All-American Canal, extending from Imperial dam on Colorado River near Yuma, Ariz., to irrigate Imperial Valley in Southern California, heavy-duty Bucyrus-Monighan dragline, equipped with huge 12-cu. yd. bucket, excavates canal prism in sand hill country. U. S. Bureau of Reclamation project, to cost about $30,000,000, involves total of 70,000,000 cu. yd. of excavation. Maximum canal section is 232 ft. wide at water surface, with bottom width of 160 ft. and water depth of 20 ft. Principal contract for 40,000 cu. yd. of excavation is held by W. E. Callahan Construction Co., of St. Louis, Mo., and Gunther & Shirley, of Dallas, Tex., with [illegible], of Baton Rouge, La., as subcontractors.

Photo [illegible] & Roberts

W. EARLE ANDREWS
is the newly appointed general manager in charge of construction at the site for the New York World's Fair in 1939. Mr. Andrews has served as deputy chief engineer of the Long Island State Park Commission and chief engineer of the Jones Beach State Park Authority. More recently, he has been general superintendent of the New York City Park system. Under his direction at the World's Fair site in Flushing, L. I., excavation and grading have been proceeding at a rate of about 40,000 cu. yd. daily.

THOMAS H. CUTLER
for many years chief engineer of the Missouri State Highway Commission and a former president of the American Road Builders' Association *(left)*, has recently accepted an appointment as state highway engineer of Kentucky. He is succeeded, in his former Missouri post, by Carl W. Brown.



D. G. COLEMAN
secretary-treasurer of the Valley Construction Co., of Memphis, Tenn., has been elected president of the newly organized National Waterway Contractors' Association, a reorganization of the former Mississippi Valley Flood Control branch of the Associated General Contractors of America. Mr. Coleman is shown with his 9-year-old son, "Micky". He has been active in dredging work in Florida and in levee building along the Mississippi River.

Present and Accounted For ~

A PAGE OF Personalities

T. T. KNAPPEN
who has been chief of the engineering division of the Muskingum flood control project, in Ohio, has been appointed chief of the flood control section for the North Atlantic Division of the U. S. Engineer Department. Prior to the Muskingum project, Mr. Knappen served as principal engineer in charge of Mississippi River levee building in the Memphis district of the Engineer Department of the Army.

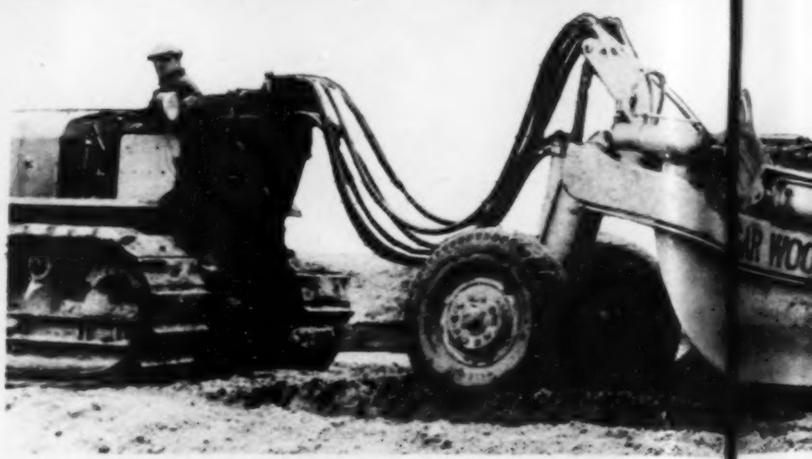
AT MONTANA'S BITUMINOUS PAVING CONFERENCE

(Left to right, back row) Emil H. Schulz, County Engineer, Ramsey County, *St. Paul, Minn.;* W. J. Flannigan, highway commissioner, *Alberta, Canada;* C. M. Duff, testing engineer, Department of Roads, *Lincoln, Neb.;* R. P. Newland, division engineer, Washington Highway Department, *Spokane;* J. E. Buchanan, testing engineer, Idaho Highway Department, *Boise;* C. A. Davidson, highway commissioner, *Alberta, Canada.*

(Front Row): C. A. Draper, bituminous engineer, Mississippi Highway Department, *Jackson;* T. R. Perry, bituminous engineer, Iowa Highway Department, *Ames, Ia.;* H. G. Nevitt, manager, asphalt department, Socony-Vacuum Oil Co., *Kansas City, Mo.;* J. G. Smith, division engineer, Wyoming Highway Department, *Cheyenne;* Carl R. Reid, materials engineer, Oklahoma Highway Department, *Oklahoma City;* W. N. Lovejoy, construction engineer, South Dakota Highway Department, *Pierre;* Seward Mason, testing engineer, Montana Highway Department, *Helena.*

NEW EQUIPMENT ...

ALL-PURPOSE EXCAVATOR, ¾-yd. capacity, is built of high tensile steel, electric welded, thereby effecting considerable weight reduction and adding greater strength in comparison with previous models. Tractor-type crawlers are also an innovation on this capacity excavator providing increased speed and mobility. All digging and travel movements have two-speed transmission with high-speed direct drive. Low gearing is possible for crane service operations. Other features: Automotive-type foot pedals; larger brakes and clutches; full-vision cab; lighter, welded-steel dipper. — Harnischfeger Corp., Milwaukee, Wis.

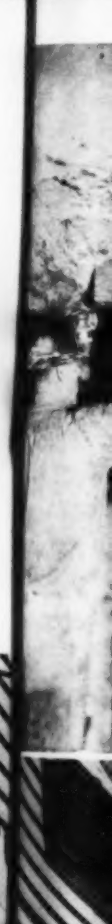


HYDRAULIC SCRAPER can excavate, haul and place 500 to 1,000 cu. yd. of earth in 8-hr. day (depending upon size of scraper and tractor used), according to claim of manufacturers who attribute speed and economical operation of machine (1) to three-point suspension of scraper, eliminating all twisting stresses; (2) all wheels are within cutting width of bowl; (3) front-truck arrangement gives dual tool for dual function, that is, (a) during loading, line of draft is straight from tractor drawbar to bowl; (b) when hauling, wheelbase is shortened to minimum to improve maneuverability. Heaped capacities, 6, 8, 10 and 12 yd. — Gar Wood Industries, Inc., 7924 Riopelle St., Detroit, Mich.

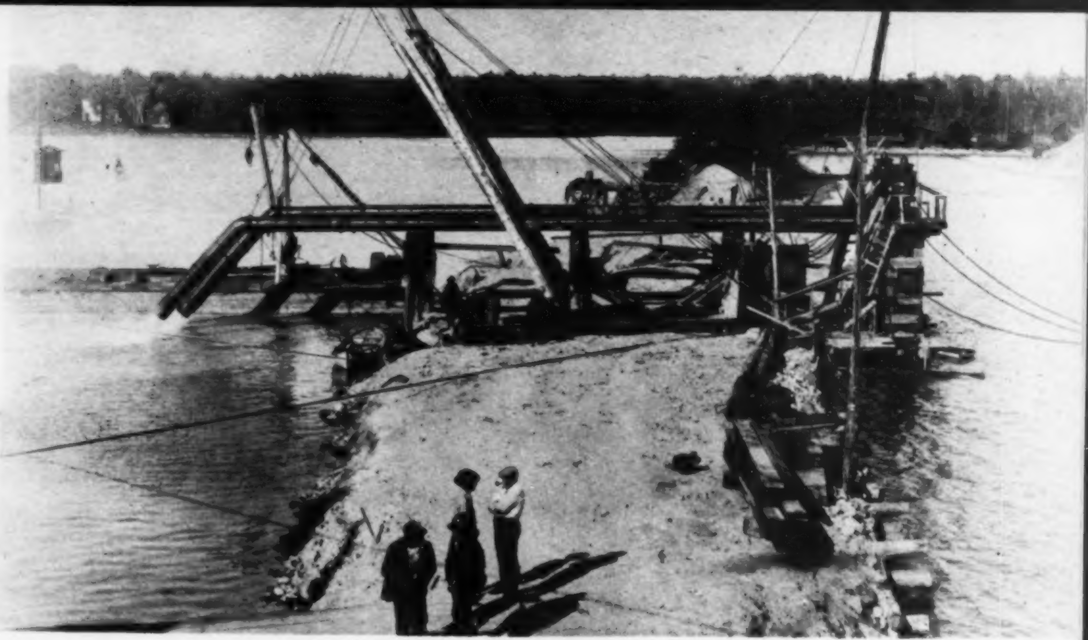
HEAVY-DUTY REVERSIBLE RATCHET WRENCH *(left)* is built for rapid operation and severe service in bridge, building and other structural jobs requiring strong, fast-action tools. Quadruple pawls instead of usual two, provide double bearing and strength with increased durability. Handles are drop-forged, not cast, to utilize extra strength afforded by pawls. Made in five sizes, 24 to 48 in. Both hex and square sockets with hole extending clear through, openings 1 1-16 to 4⅜ in., turn nuts on any length of bolt.—J. H. Williams & Co., 75 Spring St., New York.

ROCK CORK PIPE COVERING, mineral insulation for low temperature piping, is made of rock cork sheets coated with waterproofing asphalt into which is firmly embedded a waterproof jacket that becomes integral part of product. This treatment gives added protection of hermetic sealing against moisture-laden air, cause of most low temperature insulation failures. Furnished in 3-ft. sections in thicknesses ranging from 1.4 to 4 in., depending upon use. — Johns-Manville, 22 East 40th St., New York.

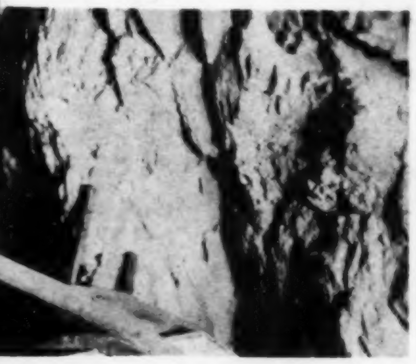
AUTOMATIC REMOTE CONTROL UNLOADER *(left)*, for handling cement, as shown in photograph, and other dry pulverized materials, has following features and improvements: (1) Rugged construction; (2) greater speed; (3) increased capacity and longer pumping distance; (4) cannot be overloaded as feeder and pump screw are independent and automatically controlled; (5) automatic feeding; (6) simpler construction — fewer parts; (7) safety from slides for operator who controls machine at distance by switch held in hand. — Fuller Co., Catasaqua, Pa.



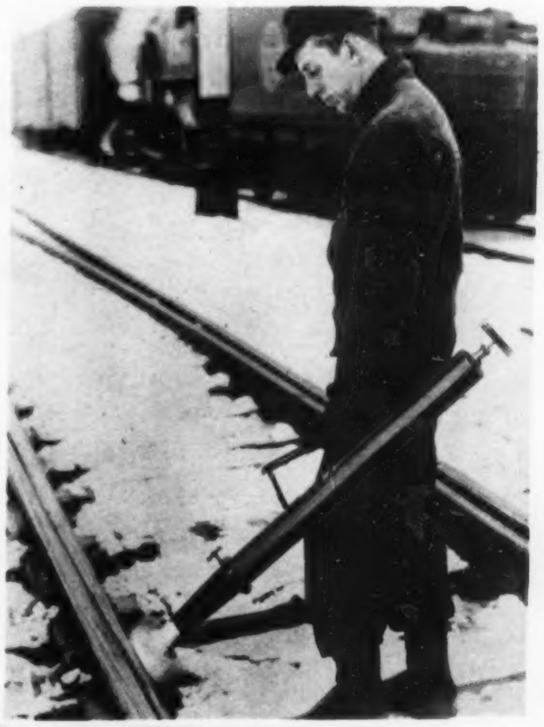
... On the Job



VERTICAL TURBINE PUMP for dewatering cofferdams, mines, quarries, etc., range in capacity up to 10,000 g.p.m. May be used either as portable sinker pump to be lowered as water level recedes or may be fitted with suitable pipe lengths for fixed installations. Weatherproof motor at top, fitted with vertical hollow shaft, is grease lubricated to prevent leakage in transit or when pump is not in vertical position. Other features: (1) Stuffing box, easily accessible; (2) stainless steel shaft; (3) grease-packed inlet vane requiring no attention; (4) bronze intermediate bushings and impeller wearing rings readily renewable; (5) galvanized basket strainer protects pump from sticks, stones and other clogging material. Rated for total dynamic heads of 20, 30, 40, 50 and 60 ft. Motor sizes vary from 5 to 250 hp., with speeds ranging from 870 to 1,750 r.p.m.— Worthington Pump & Machinery Corp., Harrison, N. J.



DRIFTER DRILL, for use on all sorts of submarine, mine and quarry operations, has improved valve design and ability to maintain strong, powerful rotation as well as positive hole blowing condition regardless of depth drilled — all of which, manufacturers claim, results in increased speed, lower maintenance costs and exceptional air economy. Drill controls are handy to operator, facilitating collaring and blowing holes and changing steel, thus saving time for output. Streamlined cylinder gives low center of gravity and makes drill flexible and easy to handle. Three models: 4-, 3½- and 3-in. bores. — Sullivan Machinery Co., 307 N. Michigan Ave., Chicago, Ill.



UTILITY BLOW TORCH *(right)* for use of railroad companies, public utilities and highway departments, is equipped with coil burner of fire-pot type which develops wide-spreading, intensely hot blue flame. Burner protected by sheet metal shield. Tank ¾-gal. capacity, made of heavy seamless brass tubing with cast bronze ends. Adjustable handle can be folded flat. Quick-action pump serves as filler plug. Torch will burn 2½ hr. on one filling of gasoline. Overall length 41 in., diameter 3 in. and shipping weight, 14 lb. Useful for fighting fire with fire, drying and burning rubbish piles, weeds and undergrowth and for quick thawing of railroad switches.—Turner Bros. Brass Works, Sycamore, Ill.

COLORED CEMENT-ASPHALT SHINGLES *(left)* were developed by giving conventional asphalt product a surface coating of special formula hydraulic cement in which mineral oxide pigments are incorporated. Colors include blues, greens, grays and reds as well as white and black. White siding material for use on Colonial exteriors also is available. In addition to decorative qualities, cement coating gives shingles rigidity and protects asphalt beneath from rays of sun so that oils and other volatile substances are not baked out. Because of rigidity it is possible to expose greater portion of shingle butt and therefore, fewer shingles are needed to cover given area.—Bakelite Corp., Bound Brook, New Jersey.

FAST OPERATION, accurate control and large yardage are three advantages claimed for this ⅜-yd. excavator. Carbody and turntable are built as integral unit of structural steel sections and plates electric welded throughout providing necessary strength with minimum dead weight of material. Each crawler is operated independently by controls extending down through hollow, vertical propeller shaft. Revolving platform is supported on four 6-in.-diameter cast-steel rollers spaced to provide well balanced support. Machinery is placed well back on platform reducing materially necessity for dead counterweight. Self-cleaning crawlers. — Insley Mfg. Co., Indianapolis, Ind.

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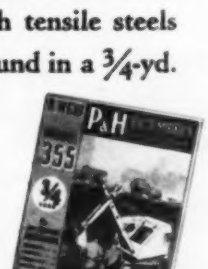

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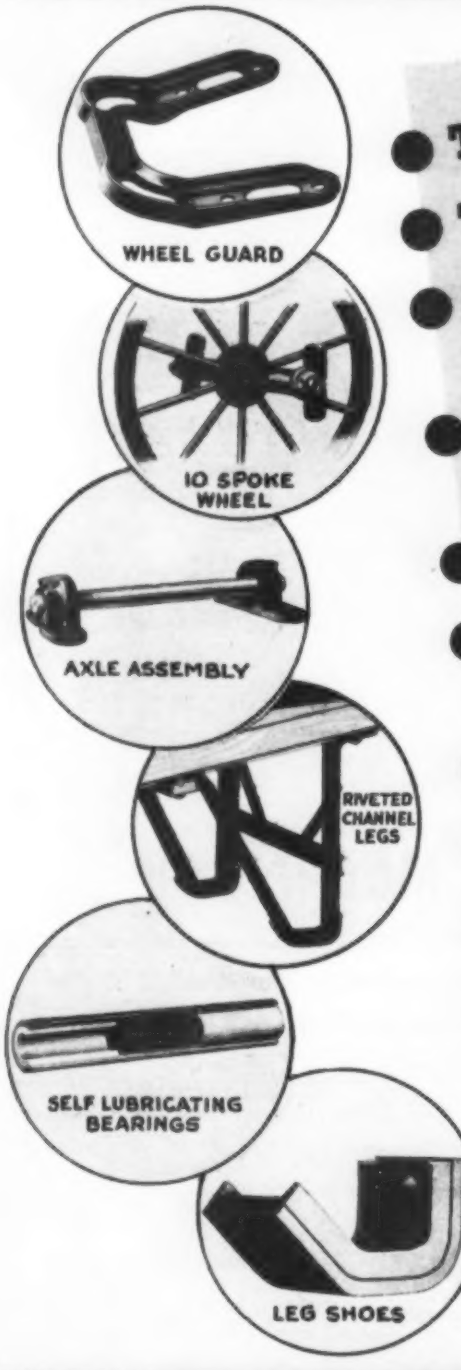
Why STERLING WHEELBARROWS ARE STANDARD FOR CONTRACTORS USE !

THEY HAVE PERFECT BALANCE



- **They are built sturdy for hard use.**
- **Trays are welded—not riveted.**
- **Double thickness of metal at corners and on sides.**
- **Continuous butt-welded rod of 11/32" diameter rolled in top edge of trays.**
- **Trays have exact struck capacity.**
- **Front Braces "V" shaped, connected by brace support at tray.**
- **Wheels have 10 spokes,—flush riveted.**
- **Self-lubricating bearings in all wheels.**
- **Handles are No. 1 clear hard maple.**
- **Wheel guard made of malleable iron.**
- **Legs are made of channel steel bent square at bottom.**
- **Leg shoes can be replaced if necessary.**

IT IS NOT A STERLING WITHOUT THE SQUARE → S

STERLING WHEELBARROW CO.

900 SOUTH 71ST STREET
MILWAUKEE · WISCONSIN, U.S.A.

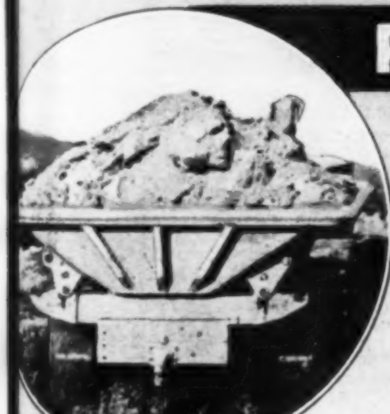
THE ECONOMICAL WAY TO HANDLE ROCK

● To move rock at a profit, use equipment that really *fits* the job. Athey Forged-Trak Side Dump Quarry Trailers, used with "Caterpillar" Diesel Tractors, free you from the handicaps and expense that out-of-date hauling methods impose . . . and give you the *balanced* performance that means true economy.

LOADING –

● Athey Forged-Trak Side Dump Quarry Trailers have big bodies, of substantial construction, to handle your big loads. They are easy to spot in close quarters. The spring-mounted chassis and the full floating drawbar cushion the impact of loading.

ROADING –



● These Trailers, with their self-cleaning non-clogging wheels, go anywhere in any weather. Used singly or in train, they assure continuous, uninterrupted hauling performance regardless of ground conditions.

DUMPING –

● A steep dumping angle allows the load to go clear of the wheels. Dumping is *clean,* due to the smooth, heavy steel plates and rounded corners. Double contact hinges assure positive return of body when working on uneven ground. Ask for complete operating data!

ATHEY Forged-Trak Dump Trailers

REG. TRADE MARK

ATHEY TRUSS WHEEL CO.

631 W. 65th Street, Dept. J, Chicago, Ill. *Cable Address:* "Trusswheel" Chicago

"I HAUL DYNAMITE"

—"YET I'M ALWAYS SAFE ON SILVERTOWNS,"

says **A. D. PROSPERO**

"I haul 3- to 6-ton loads of dynamite and black powder. We travel all kinds of roads in all kinds of weather, but I'm always safe on Silvertowns."

That's A. D. Prospero of Masontown, W. Va. speaking. His two trucks haul dangerous explosives used in mines, quarries and road-building. Night and day they thread their way over rocky, winding mountain roads. Down steep hills. Round hairpin curves. With a load capable of blowing an army to bits!

There's a real job for truck tires. One where they just can't have tire failures. Goodrich Triple Protected Silvertowns averaged 48,000 miles on the truck pictured here!

There's a good reason for this amazing performance. Goodrich Silvertowns are specially built to stand up on the world's toughest hauling jobs. They are Triple Protected in the sidewall—fortified right at the point where 80% of all premature failures occur. This extra protection means extra miles—freedom from dollar-stealing sidewall breaks.

Triple Protection Free

The tires that set mileage records on hazardous hauls in the West Virginia mountains will do a better job on your trucks, too. You pay no premium for Silvertowns. Triple Protection makes tires more expensive to build but it costs you nothing extra.

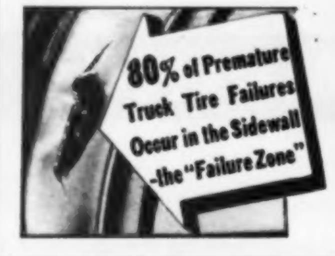
See any Goodrich dealer or write The B. F. Goodrich Company, Akron, Ohio.

HOW TRIPLE PROTECTION WORKS

1 **PLYFLEX**—distributes stresses throughout the tire—prevents ply separation—checks local weakness.

2 **PLY-LOCK**—protects the tire from breaks caused by short plies tearing loose above the bead.

3 **100% FULL-FLOATING CORD**—eliminates cross cords from *all* plies—reduces heat in the tire 12%.

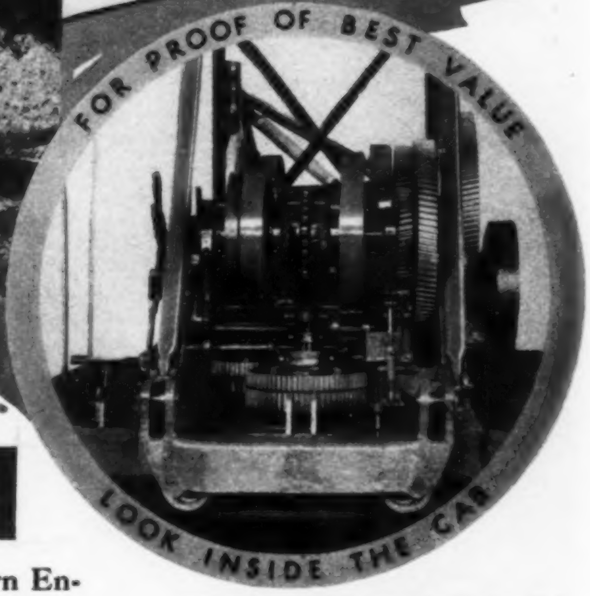


Goodrich *Triple Protected* Silvertowns

SPECIFY THESE NEW SILVERTOWN TIRES FOR TRUCKS AND BUSES


Roebling...
The pacemaker in
wire rope development
JAR
THE most exacting basis for judging wire rope performance is AVERAGE SERVICE.
This is the basis advocated by Roebling, in which rope cost per ton of material handled, or per other unit of service measurement, is based not on the service of a single rope but on the *average* service of several ropes.
John A. Roebling's Sons Co., Trenton New Jersey

Note
the demand for Bay City performance has sold out production for weeks ahead!



MODEL "20" BAY CITY proves value in the cab-- and on the job

Not only has Bay City "20" all the *heavy duty* features of modern Engineering—it has also demonstrated that fact to the host of owners in actual service—it's not a "catalog" shovel—it's a real DIGGER.

Compact Design—yet plenty of elbow room.
Elimination of useless "dead weight"—by alloy steels and heat treating.
Anti-friction bearings on all machinery shafts, and Boom Point Sheaves.
Chain Crowd—positive and independent—costs more but worth it.
Drop forged crawler shoes (14" wide), long wearing life.
Unit Cast Car Body and Machinery Table of nickel-manganese steel, totally heat treated—available on no light ⅜ yd.
Six Cylinder Gasoline or Diesel Power—"E-Z" Clutch Control.
Cut Helical Gears on all drum shafts—Helical gear drive, in oil.
Safety Worm Boom Hoist—Positive Swing Lock—Cab in any position.
Positive Propelling Lock—All controls from operator's seat.

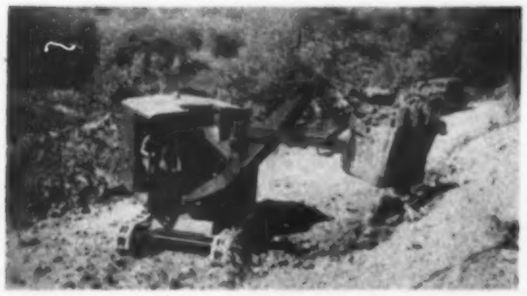
No—Bay City "20" is not a TOY. It's as RIGHT as any full revolving shovel CAN be—it tops the field in speed, power, built-in endurance available on no machine in its weight and price class. You can't do better than a "BAY CITY"—no matter what your shovel needs!

WEIGHS ONLY 10 TONS

Also ½—⅝—¾—⅞—1—1¼ yard sizes

25 REASONS FOR CHOOSING BAY CITY

1—Convenient economical weight.
2—Helical cut gears—noiseless, long wearing.
3—Unit (nickel-manganese) car body and machinery table, totally heat treated.
4—Frictionless bearings thruout.
5—6-cylinder power.
6—Extra large diameter swing roller-path.
7—Oversized clutches & brakes.
8—Drop forged crawler shoes.
9—Long crawlers—low bearing pressure.
10—Chain crowd with automatic adjustment.
11—Swing lock—in any cab position.
12—Automatic Travel lock.
13—Extra heavy cab. Plenty inside working room.
14—Fast operating speeds.
15—Two travel speeds.
16—All steel construction.
17—Three lever control.
18—E-Z clutch control.
19—High pressure lubrication thruout.
20—Safety worm boom hoist.
21—Separate hoist drums.
22—Internal swing teeth.
23—Unequalled steering at full speed.
24—Convertible — without machinery change.
25—Accessibility for inspection or adjustment.



Send for details

Recent Quantity Purchasers: 8 Model 20's State of N. Y. Dpt. of Pub. Wks.; 7 for New Zealand Pub. Wks. Dpt.

BAY CITY SHOVELS Inc. (Eastern Offices, Roselle, N. J.) **BAY CITY, MICH.**

● Alemite Systems prevent bearing failures. And you know how expensive bearing failures can be when you're meeting contract dates. That's why more than 95% of all modern construction machinery is factory-equipped with Alemite Lubrication Systems.

The shovel, tractor, or concrete mixer which is lubricated by an Alemite System doesn't need lubricating so often—and each application takes less time. The Alemite Gun develops tons of pressure to force clean lubricant into the bearings, driving out the old, dirty, worn-out grease at the same time.

Alemite Fittings are hardened to take all kinds of punishment. And they are sealed to keep dirt, dust, and grit from getting in and grinding away your bearings. They open only to admit lubricant under pressure.

Get your share of the thousands of dollars Alemite is saving for contractors every year! There is an Alemite System, power or manually operated, to save you money on every machine you use. Read the money-saving facts in our new booklet, "The Road to Greater Profits in the Operation of Construction Machinery."

It's *free*. Mail the coupon today!

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CONTROLLED LUBRICATION

Enjoy Horace Heidt and his Alemite Brigadiers every Monday Evening on CBS Coast-to-Coast Network. See local papers for time of broadcast.

Practical facts on every phase of building construction!

HERE is a Library of books that are packed to the covers with the best plans and methods for speeding up production, saving materials and labor, and cutting costs. These six books cover every phase of practical construction work from estimating building costs to the selling of construction service—from plan reading and quantity surveying to practical job management. With the aid of these books the contractor can get business in these dull times by learning how to make savings, and through them being able to make lower bids. The construction superintendent can learn how to keep costs down, which insures his job these days.

The Dingman Building Contractors' Library

The Dingman books have won a wide reputation among builders and building contractors for their sound, practical and easy-to-understand discussion of building construction work. All of the material has been drawn from actual practice.

This library is intended for —

[1] The building contractor who wants a handy reference set that will give him almost instantly a ready answer to most of the problems that come up in the course of the day's work.

[2] The young men in the building industry who intend to make the business of construction their life work, and who want the kind of guidance that will aid them to climb to the top.

[3] Everyone in the building industry who wants to keep his job by increasing his usefulness and efficiency.

Each one of the volumes in this set is a complete handbook on some important subject. Sturdily bound and pocket size, it will go right "on the job" with you for immediate consultation.

Practical data is given on analyzing a construction job into its component parts—estimating the costs of labor, haulage, equipment, materials, etc.—plan reading and determining quantities from specifications—personnel management—successful supervision of every building operation—efficient and economical business methods—office procedure such as accounting banking, purchasing, etc.—advertising and selling methods for contracting service—and a complete data book of tables, forms and calculations most frequently used by the builder.

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Without a cent of expense—without any obligation on your part—you may examine the Dingman Building Contractors' Library for 10 days and determine its value for yourself. Try the books out on your everyday problems—make them prove their worth to you. Unless they meet every test send them back at our expense. If the books prove satisfactory and you decide to keep them, pay only $1.50 in ten days and then $2.00 a month for six months.

Every contractor and builder, every architect and engineer, every student and executive, who is seeking practical help on the everyday problems connected with building construction work should have this valuable reference library.

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You may send me for 10 days free examination, the new six-volume Dingman BUILDING CONTRACTORS' LIBRARY. I agree either to return the books postpaid at the end of 10 days or send a first payment of $1.50 then and $2.00 a month for six months.

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EACH HEAD TURNS TWO DIFFERENT SIZED NUTS

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A TIME SAVER

Time and Money Saved with the

FAVORITE

REVERSIBLE RATCHET

WRENCH

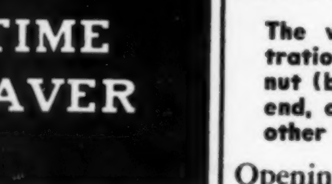
As Each Head Is Double-Ended.

This means there are fewer parts to keep on hand, and less time wasted in changing heads in handle to turn different-sized nuts.

The wrench in illustration turns 1" Hex. nut (bolt size) on one end, and 1 1/8" nut on other end.

Opening in head allows bolt to pass clear through.

Reverse Action Instantaneous by Turning Pawl. Wrench can be used in narrow spaces.



Works on a straight-ahead Ratchet Movement. Does not leave nut until operation is completed.

SEND FOR FULL PARTICULARS

GREENE, TWEED & CO.

Sole Manufacturers

109 DUANE ST. NEW YORK, N. Y.

200 per cent increase in *concrete* home construction this year over last!

A reinforced concrete home under construction in California — using one of many economical forming methods available to the contractor.

PROFITS FOR CONTRACTORS IN CONCRETE HOMES

SWAMPED WITH JOBS. Albert Bill of Detroit built 15 concrete houses this Spring and since then has continued a program of starting 8 new houses every 60 days. He now has more inquiries and requests to build concrete homes than he can handle.

A big new market has cracked wide open for alert general contractors. Take as an example the case of Albert Bill of Detroit who is really cashing in on the fast growing acceptance for concrete homes. You can do the same! Ally yourself with one of the many sub-dividers or realtors who are either organizing construction departments or making connections with builders. There's real profit in these cooperative arrangements.

Building beautiful, firesafe, economical homes of concrete is really *your* job. Capitalize on your skill and experience by organizing the construction of foundations, walls, floors and stairways. Equip yourself to build these homes whether of masonry or reinforced concrete. You'll find plenty of profitable extras in porches and terraces, walks, driveways and garages.

Remember, concrete homes are filled with features that make for quick, easy sales. And they can be built economically — one at a time or by the hundreds!

We will be glad to discuss this opportunity with you. Write us or pin coupon to your letterhead.

PORTLAND CEMENT ASSOCIATION

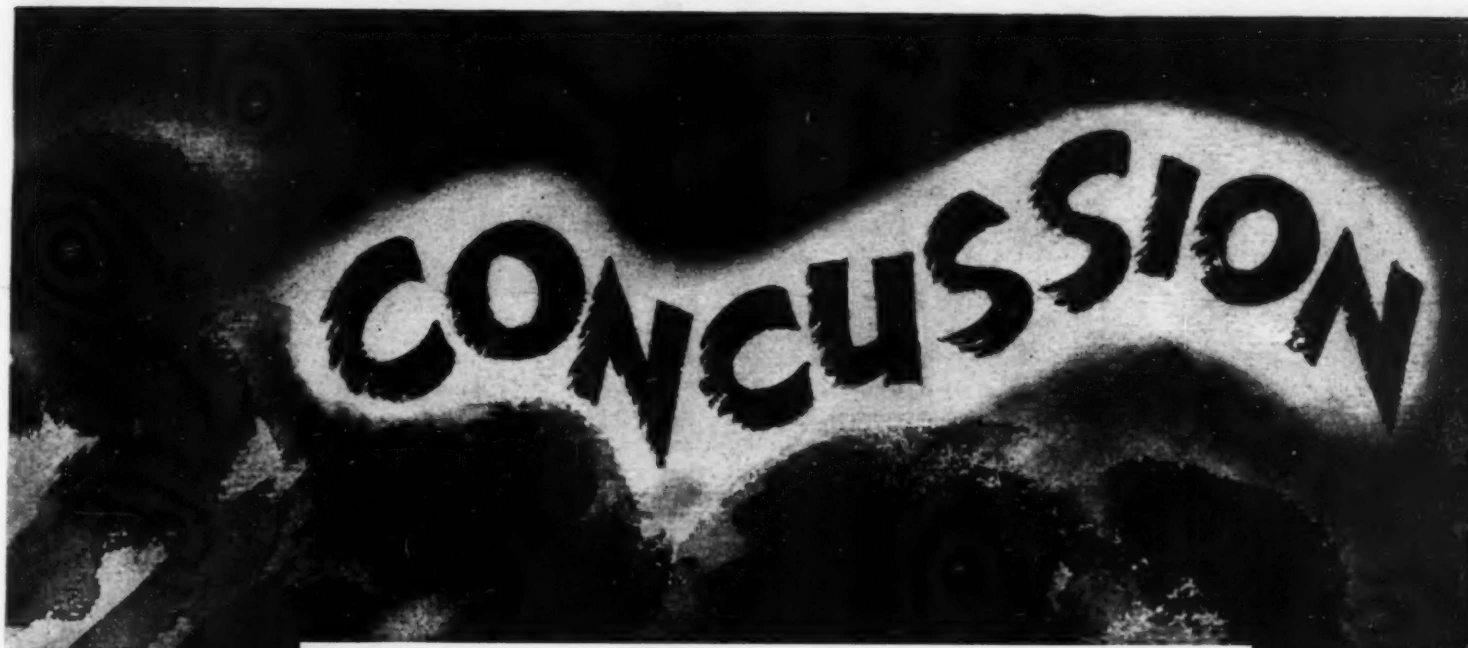
Dept. A10-16A, 33 W. Grand Ave., Chicago, Ill.

Yes, I am interested in the contracting opportunities presented by the concrete house. ☐ Send copy of *"Designed for Concrete"* showing 55 examples of concrete home designs and typical construction details.

Name of Co. ....

Address ....

City .... State ....



CONCUSSION—*the destructive aftermath of blasting*—IS DEATH TO ORDINARY TUBING - - -

A flexible ventilating duct that might stand up under every test given it in a laboratory might find itself as useless as a piece of old dimity after a half dozen blasts underground.

The concussion which follows a blast, finding no escape by way of the working face, the floor, or the ceiling of the tunnel, rushes backwards toward the tunnel's mouth like a tidal wave. In line to receive the whole force of that concussion is the line of flexible ventilating duct which literally dances on the concussion, slashing itself against neighboring rocks.

It is at the moment of concussion that du Pont Jute "Ventube" plays so excellent a part.

Jute "Ventube" is made of extra heavy, long fibered Hessian cloth impregnated and coated with rubber by a process that makes this type of flexible tubing the toughest and strongest on the market.

The reason for Jute's ability to "take it" lies in the fact that it is just as strong in tear resistance in the warp direction as it is in the filler and because of the added strength of our special Jute fabrics. Obviously, if your duct is strong in one direction and weak in the other it will burst along the lines of least resistance. This completely explains rips that sometimes extend for half the length of a section of tubing.

Construction engineers who have tumbled to these "reasons why" for Jute "Ventube" will now use no other. If you are now not using Jute "Ventube" we urge you by all means to install a half dozen sections leading up to the working face so that you can observe it under actual tunneling conditions.

DU PONT
VENTUBE

E. I. DU PONT DE NEMOURS & CO., INC.,
Fabrikoid Division,
FAIRFIELD, CONNECTICUT

The Flexible Ventilating Duct

LINK-BELT

Speed-o-Matic

SHOVEL-DRAGLINE-CRANE

- ★ MAINTAINS TOP EFFICIENCY
- ★ SPEEDS UP THE JOB
- ★ INCREASES OUTPUT
- ★ ***REDUCES COSTS***

• Now it is no longer necessary to pay the penalty of operator fatigue. Speed-o-Matic eliminates the back-breaking effort of manipulating mechanical levers which wear down the operator's efficiency. Short, easy throw wrist-motion levers and foot pedals operated from a comfortable sitting position, make shovel-dragline-crane operation simple and easy. Top machine-efficiency is maintained all through the work shift.

SENSATIONAL RESULTS!

The tremendously increased production resulting from the use of the Speed-o-Matic is actually amazing. A small Speed-o-Matic moves more material than a larger size old-style mechanical lever unit.

MORE PROFIT ON EVERY JOB!

The speedier operation and increased output of the Speed-o-Matic lowers costs and reduces waiting time of trucks and other auxiliary equipment. Link-Belt Company, the Leading Manufacturer of Materials Handling Equipment for Over 60 Years. 300 West Pershing Road, Chicago. Offices and Distributors in Principal Cities.

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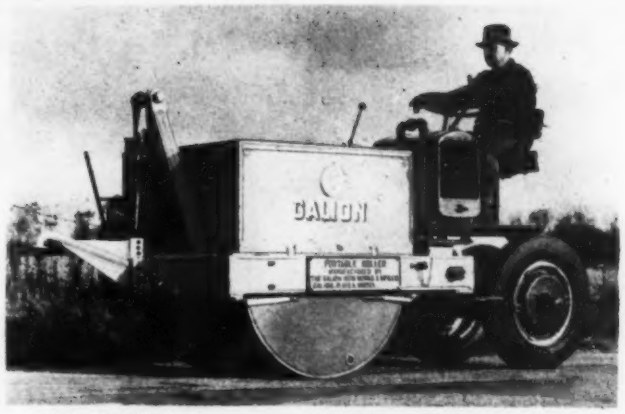
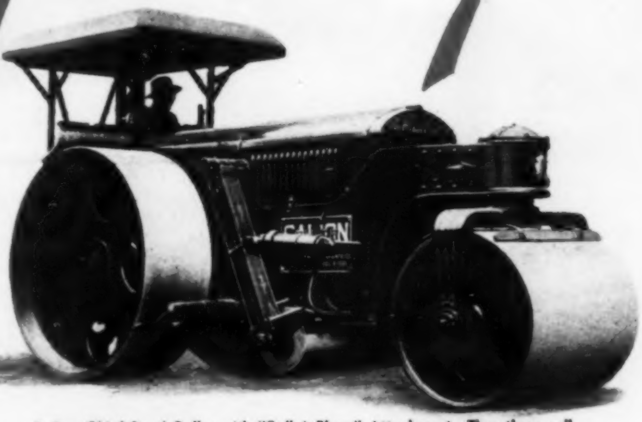
YOU OWE IT TO YOURSELF TO INVESTIGATE

LINK-BELT *Speed-o-Matic*

Galion



Galion Portable Roller—an economical, versatile unit for rolling all kinds of patch material . . . for compacting loose material, rolling drives, lawns, etc.



Galion Chief Road Roller with "Roll-A-Plane" Attachment. Thus three rolling units are provided, each of a different diameter and so constructed that the three rolls may be placed upon the same exact plane, producing a surface not only free from waves, vibration and impact, but also simplifies the method and reduces the cost of rolling.

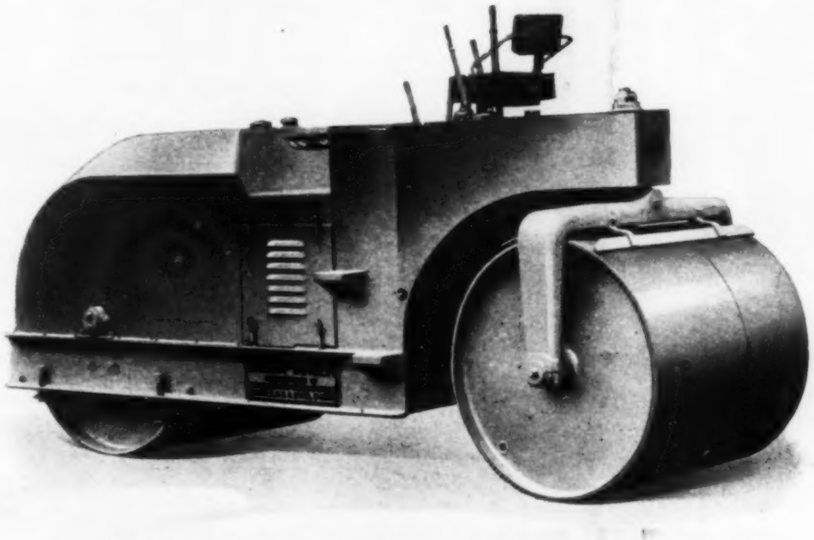
Rollers

There is more than "Just Rollin' along" with Galion Rollers. It's true they roll along in grand shape but a good roller must do more than that. It must have a dependable motor; flexibility and smoothness of operation; be able to cover ground in a day's time; be sturdy in construction and economical in operation.

Galion Rollers have all of these requisites. From every angle . . . appearance, workmanship, power, control and performance . . . Galion Rollers are leading the field. And there is a roller in the broad Galion line of a type and size to meet any rolling requirement you may have.

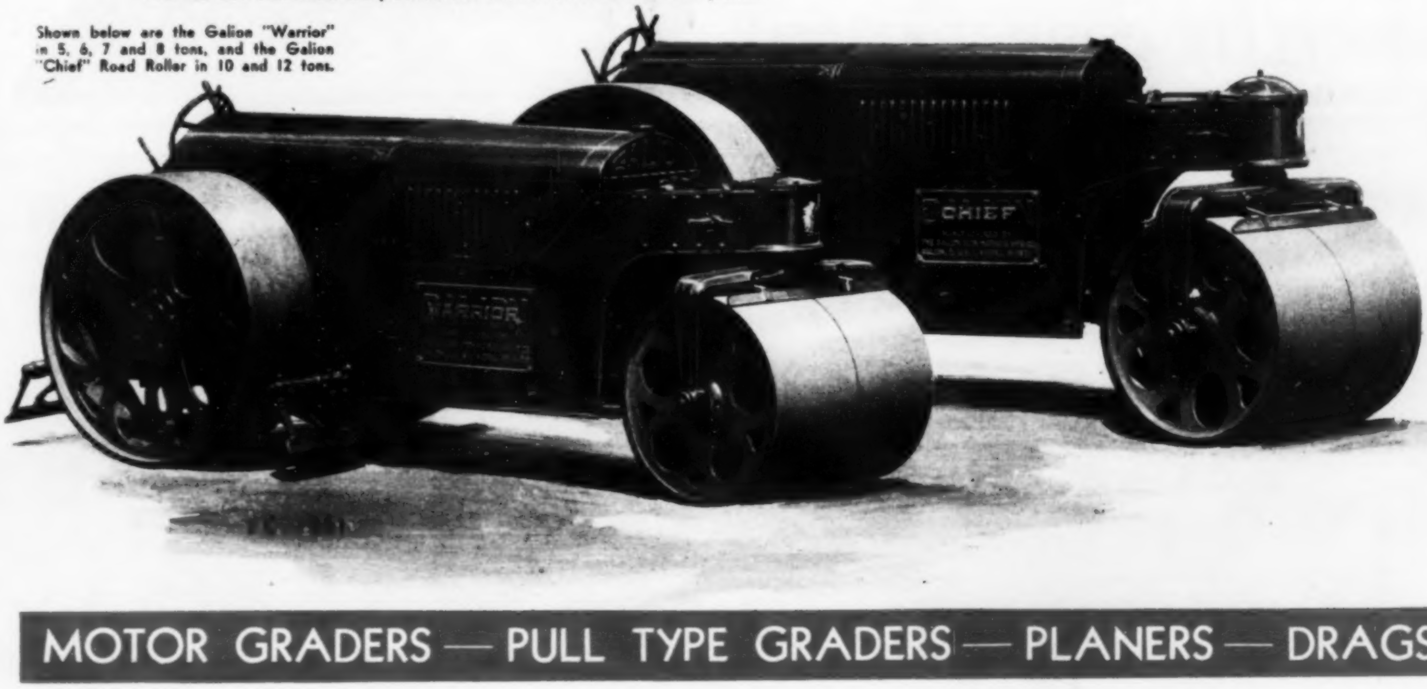
Galion Engineers know Road Rollers . . . they have been building them for a good many years now. They are constantly studying and improving the line to give you the best there is to be had. We pass this experience on to you. Call on Galion.

The Galion Iron Works & Mfg. Co.
Galion Ohio

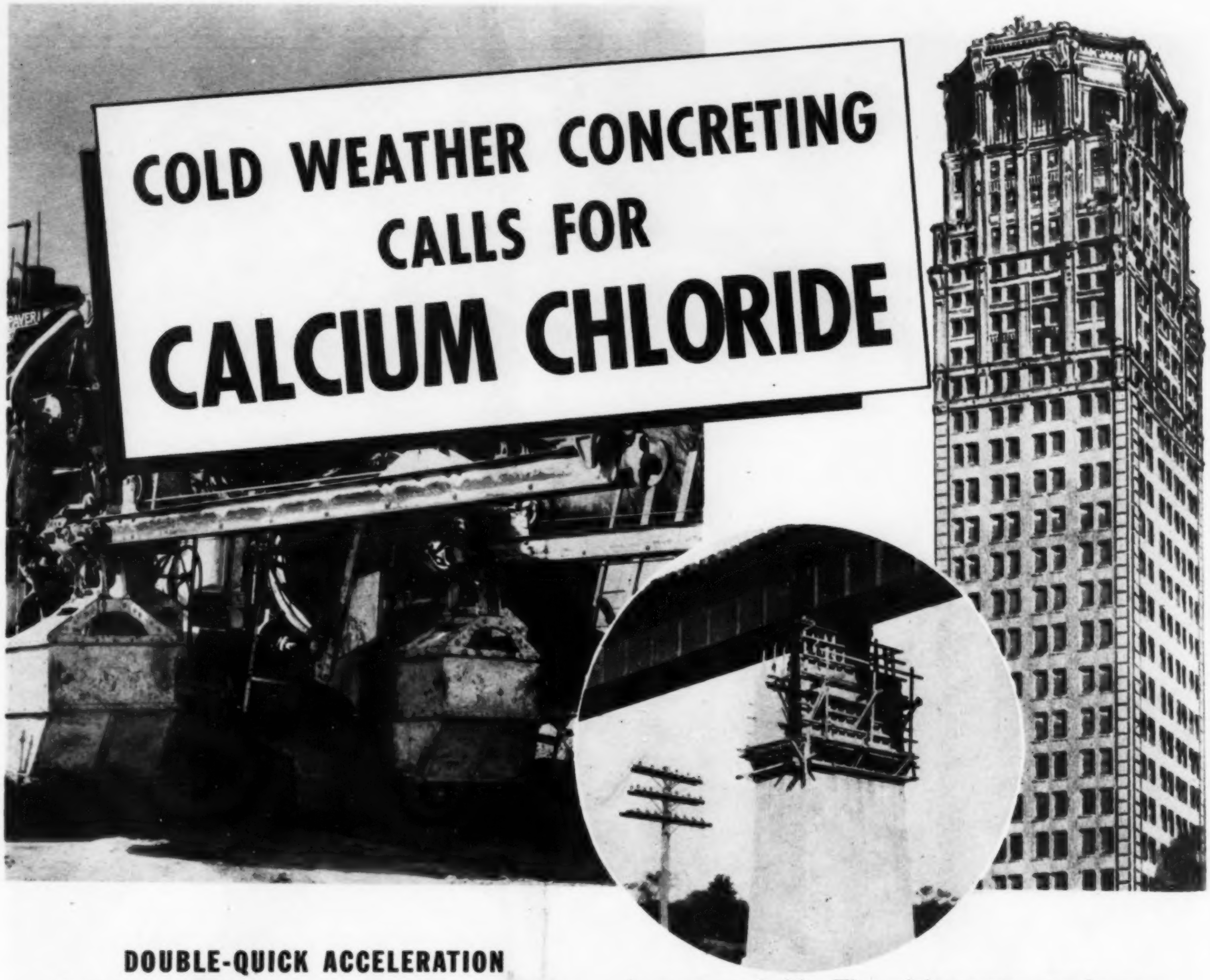


Galion "Variable Weight" Tandem Roller. Weight is variable between 7 and 10 tons, making this roller the most economical and practical ever offered to road builders and pavers.

Shown below are the Galion "Warrior" in 5, 6, 7 and 8 tons, and the Galion "Chief" Road Roller in 10 and 12 tons.



MOTOR GRADERS — PULL TYPE GRADERS — PLANERS — DRAGS



DOUBLE-QUICK ACCELERATION

Concrete construction is practicable the year round when calcium chloride is used to accelerate curing. Concrete requires proper curing at all temperatures and at all stages, but the strength accelerating value of calcium chloride admixture is most pronounced in cold weather work. This fact has been established by the National Bureau of Standards, Highway Research Board, Portland Cement Association, and other authorities.

HIGHER EARLY AND ULTIMATE STRENGTH

And what is more, to quote from the National Bureau of Standards' report: *"Calcium Chloride not only greatly increases the early strength, but also appreciably increases the three year strength. All concretes with Calcium Chloride have greater strength than plain concrete, at all ages."*

PLUS THESE ADDITIONAL ADVANTAGES

Concrete containing calcium chloride admixture is more workable. The mixing water can be reduced, thus making the concrete denser and more water-tight with increased durability.

No job is too large, none too small, to use calcium chloride to great advantage. Whatever concrete construction you do in the coming months, find out how calcium chloride will help you obtain better results at lower cost.

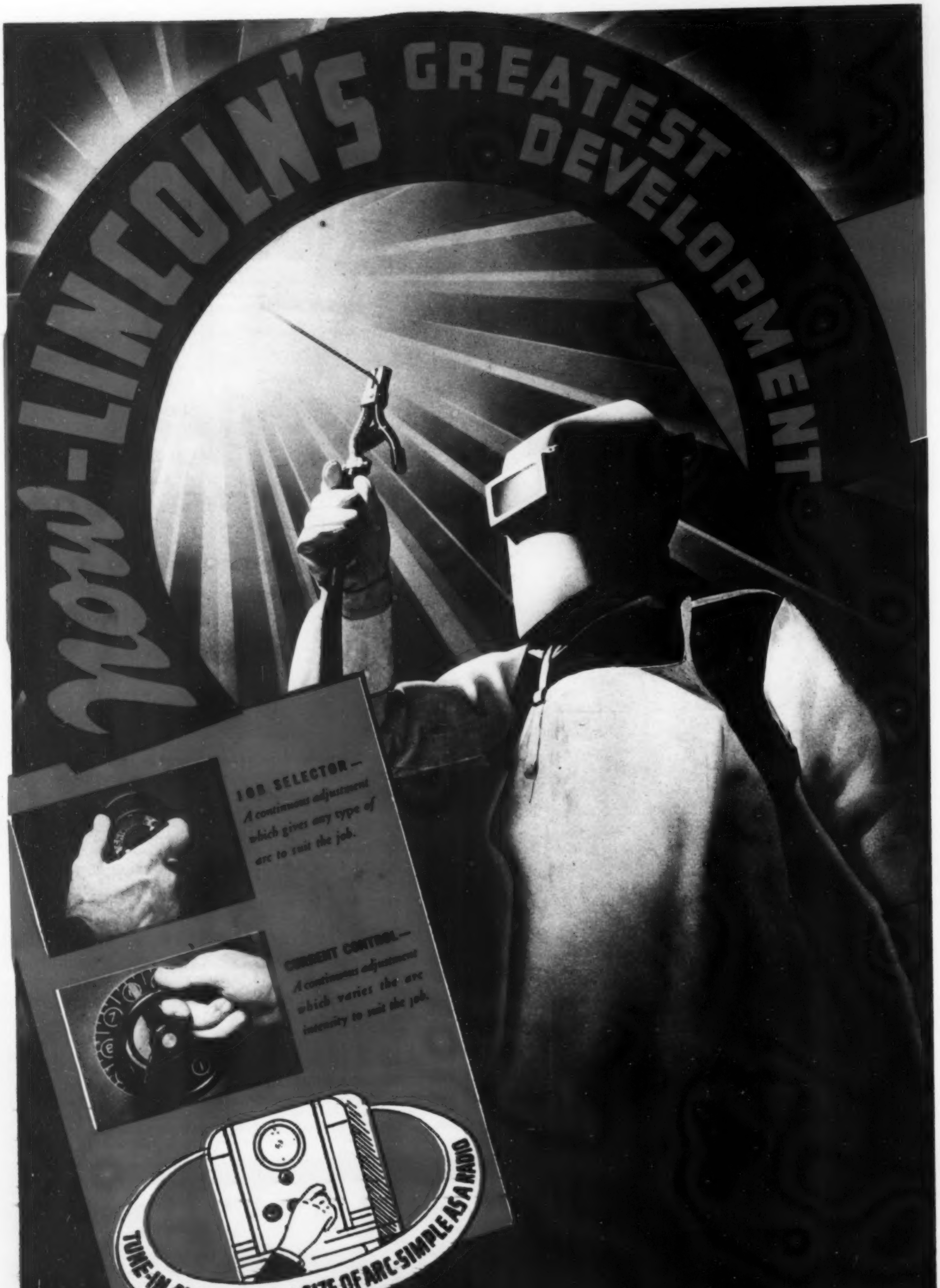
WRITE FOR FULL INFORMATION

Complete data on methods and specifications of calcium chloride admixture in concrete is available to all construction officials and contractors. Address your request to any Association member.

Calcium Chloride Association

The Columbia Alkali Corporation . . Barberton, Ohio
The Dow Chemical Company . . . Midland, Michigan
Michigan Alkali Company . 60 E. 42nd St., New York City
Solvay Sales Corporation . 40 Rector St., New York City

CALCIUM CHLORIDE
FOR MODERN CONCRETE CURING


now-LINCOLN'S GREATEST DEVELOPMENT
JOB SELECTOR—
A continuous adjustment which gives any type of arc to suit the job.
CURRENT CONTROL—
A continuous adjustment which varies the arc intensity to suit the job.
TUNE-IN ANY TYPE and SIZE OF ARC-SIMPLE AS A RADIO

DUAL *Continuous* CONTROL

and the New "SHIELD-ARC S. A. E." *Welder*

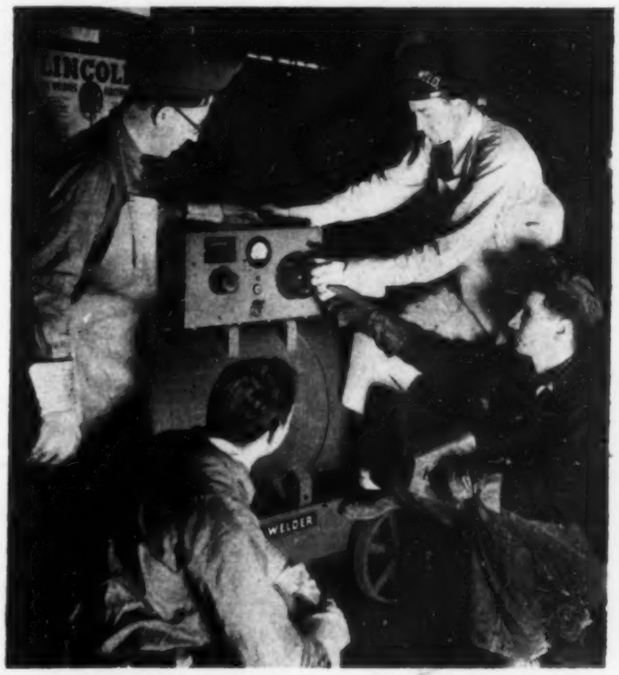
WHEN you simplify and speed-up welding, you increase the dividends it pays. When you improve the quality of your welding, you make the product more desirable . . . When you give the welding operator the sharply-tuned arc each particular job NEEDS, you have paved the way for these benefits.

These results are now available!

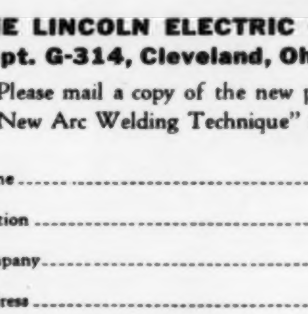
Three years of intensive development work in Lincoln laboratories, supplemented by a year of thorough and diversified field-usage, have produced a vastly improved welding machine . . . one that is far ahead of anything else!

Now, with the ease of tuning-in a modern radio, welders can select *any type of arc for each and every value of welding current . . .* assuring the *right arc* for every job . . . *everytime.* This new convenience, DUAL *Continuous* CONTROL on the New *"Shield-Arc* S. A. E." Welder, improves the speed, quality and ease of welding.

A book has been carefully compiled to give the executive, the engineer and the shop man the facts each should know to be abreast of this development which will sweep into every shop, mill, mine and construction project. This book is replete with illustrations, curves of performance, comparisons with general practice. The coupon will bring a personal copy to your desk. THE LINCOLN ELECTRIC COMPANY, Dept. G-314, Cleveland, Ohio. Largest Manufacturers of Arc Welding Equipment in the World.



The New "Shield-Arc S. A. E." with its DUAL Continuous CONTROL has been thoroughly tried for more than a year—service proven by many welding users. Welders the world over now can make the arc welding process mean more to themselves and to their employers than ever before!



FREE—Complete details of this outstanding development. Mail the coupon.

Largest Manufacturers of Arc Welding Equipment in the World

LINCOLN

THE LINCOLN ELECTRIC CO.
Dept. G-314, Cleveland, Ohio

Please mail a copy of the new publication, "The New Arc Welding Technique" to this address—

Name ....

Position ....

Company ....

Address ....

City .... State ....

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An index of products made by manufacturers whose advertisements appear in this issue of Construction Methods.

If you do not find all you need in the advertising section, we shall be glad to assist you. Write to—

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PIPE INSTALLATION METHODS
Hydranger Corp.
PIPE, METAL
American Rolling Mill Co.
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PLATES, STEEL
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PULLERS, HAND-POWER PORTABLE
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Construction Machinery Co.
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Homelite Corp.
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PUMPS, STATIONARY
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Novo Engine Co.
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RAIL & RAIL JOINTS, FASTENINGS & SPECIALTIES
Inland Steel Company
ROAD OIL & PRESERVATIVES
Barrett Company
Texas Company
ROAD FINISHERS & MACHINES, CONCRETE
Blaw-Knox Company
ROAD MACHINERY
Austin-Western Road Mchry. Co.
ROAD SURFACING HARROWS
Insley Manufacturing Co.
ROLLERS ROAD
Austin-Western Road Mchry. Co.
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ROOFING
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ROPE, WIRE
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Construction Machinery Co.
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Euclid Road Mchry. Co.
Galion Iron Wks. & Mfg. Co.
Harnischfeger Corp.
SCREENS, SAND, GRAVEL & COAL
Acme Road Mchry. Co.
Link Belt Co.
Wickwire Spencer Steel Co.
SHEETS, IRON & STEEL
American Rolling Mill Co.
SHORES, ADJUSTABLE
Construction Specialties Co.
SHOVELS, HAND
Ames Baldwin Wyoming Co.
SHOVELS, POWER
Austin-Western Road Mchry. Co.
Bay City Shovels, Inc.
Bucyrus-Erie Co.
Harnischfeger Corp.
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Koehring Company
Link Belt Co.
Northwest Engr. Co.
Thew Shovel Co.
Universal Crane Co.
SNOW PLOWS & LOADERS
Austin-Western Road Mchry. Co.
Galion Iron Wks. & Mfg. Co.
SPREADERS, BALLAST
Bucyrus-Erie Co.
SPREADERS, BITUMINOUS SURFACE
Barber-Greene Co.
Jaeger Machine Co.
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Galion Iron Wks. & Mfg. Co.
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STEEL, ALLOY
International Nickel Co., Inc., The
STEEL, STRUCTURAL
Inland Steel Company
Jones & Laughlin Steel Co.
TAR
Barrett Company
TARPAULINS
Fulton Bag & Cotton Mills
TENSION INDICATOR
Martin-Decker Corp.
TIRES, TRUCK
Goodrich Rubber Co., B. F.
Goodyear Tire & Rubber Co.
TOOLS, PNEUMATIC
Schramm, Inc.
TRACKS, INDUSTRIAL PORTABLE
Jones & Laughlin Steel Co.
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Allis-Chalmers Mfg. Co.
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Caterpillar Tractor Co.
Cleveland Tractor Co.
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TRAILERS, DUMP & CRAWLER WHEEL
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Athey Truss Wheel Co.
Austin-Western Road Mchry. Co.
Euclid Road Mchy. Co.
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TRUCKS, MOTOR
Euclid Road Mchy. Co.
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WAGONS, DUMP & CRAWLER WHEEL
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Chain Belt Company
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WHEELBARROWS
Sterling Wheelbarrow Co.
WHEELS, TRACKLAYING TYPE
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Roebling Son's Co., J. A.
WOOD PRESERVATIVES
Barrett Company
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Trimont Mfg. Co.

For page reference see advertisers index, page 90

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HAND or WET PROCESS

Make concrete pipe on the job with *Quinn Pipe Forms*. Produce uniform concrete pipe of highest quality.

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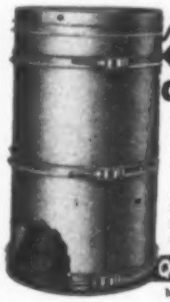
Built to give more years of service—sizes for any diameter pipe from 12 to 84 inches—tongue and groove or bell end pipe—any length.



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Meet the demand for low cost equipment that produces a uniform quality of pipe in smaller amounts. Same sizes as "Heavy Duty," from 12 to 84 inches—any length.

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For prices and features of Quinn Pipe Forms. Give us size of job for estimate on your pipe form needs. Also manufacturers of concrete pipe machines for making pipe by machine process.

QUINN WIRE & IRON WORKS
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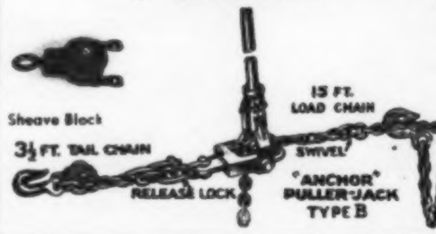

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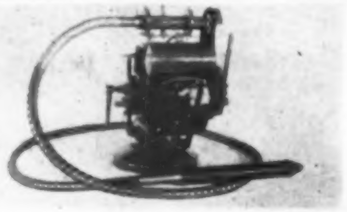

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Write for Circular on types, sizes and prices
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MODERN HORIZONTAL BORING MACHINE
For Underground Installation of Pipe and Conduits. Avoids damage to costly pavements and saves time.
Send for Bulletin
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116 New Montgomery St. • San Francisco, California

CORRECTION

Due to a typographical error the advertisement of the Rogers Bros. Corp. on Page 93 in the September issue indicated that a Rogers New 40 Ton Pneumatic Tired Trailer was described and illustrated. This should have read 50 Ton.

We take pleasure in making this correction.
CONSTRUCTION METHODS

"ACME" ROAD MACHINERY
Heavy Duty—Larger Capacity—Longer Life—

Try a new Acme Reduction Crusher or a new Acme H. D. Roller Screen on your new job.

Guaranteed rebuilt or used equipment available on attractive lease or sales contract.

For Satisfaction and Service use Genuine "ACME" Parts. Communicate with nearest Dealer, main office—*Frankfort, N. Y. or 120 Liberty St., New York City.*

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Keep Your Wet Jobs Ahead Of Schedule
The Choice of Contractors who investigate efficiency and cost
Job layouts and estimates furnished
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STRAIGHT EDGES — Aluminum or Steel • EDGERS — Stamped or Cast Iron • HAND FLOATS — Standard or Special • BULL FLOATS and HAND SCREEDS • CONCRETE BROOMS of Bass or Bassine.

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FOR EVERY PLACING PROBLEM
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The Mexican Government has requirement for a number of high grade Superintendents on the construction of rock-fill, concrete and earth dams. Salary will be such as necessary to obtain the services of thoroughly competent and experienced men. An applicant should communicate with the Director, Comisión Nacional de Irrigación, Balderas 94, Mexico City, stating in detail his qualifications and experience, the names and addresses of former employers, when he can report for duty if offered employment and salary expected.

POSITION WANTED

Experienced draftsman desires position with organization in eastern part of the United States. Trained at The Pennsylvania State College. Now mployed by Pennsylvania Department of Highways. P. W., 115 Construction Methods, 330 W. 42nd S., New York City.

NEW ADS

New advertisements for the November issue of Construction Methods should be received at our New York office by Oct. 21.

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THIS COUPON SAVES THE BOTHER OF BORROWING—AND BRINGS YOU YOUR OWN COPY OF CONSTRUCTION METHODS EACH MONTH—WITH A HOST OF NEW FEATURES YOU'LL WANT TO KEEP FOR REFERENCE

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I want to save $1 on a subscription at the Special Two Year Rate of $3. (Check here ☐ if you prefer one year — 12 issues — for $2.)

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AT one large Michigan plant two Gantry cranes equipped with magnets are used to unload boats of scrap iron. This is a difficult operation because it is frequently necessary to swing the magnet so that it will pick up scrap located underneath the coamings. This results in tough abrasion on the rope when it scrapes along the coaming of the hatch. Sometimes the friction is heavy enough to strike sparks.

This grinding used to break crown wires fast, and when broken it would drive them back into the rope. This resulted in early destruction and difficult handling. The *average* service was six boats per rope.

Then they tried LAY-SET Preformed and found that it lasted much longer and is easier to handle because broken crown wires lie flat and in place. *Consistently,* LAY-SET Preformed ropes are unloading an average of 14 boats.

Specify LAY-SET Preformed for your job. The tougher the job the more you need LAY-SET.

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HAZARD WIRE ROPE COMPANY, Inc.
Wilkes-Barre, Pennsylvania
An Associate Company of the American Chain Company, Inc.

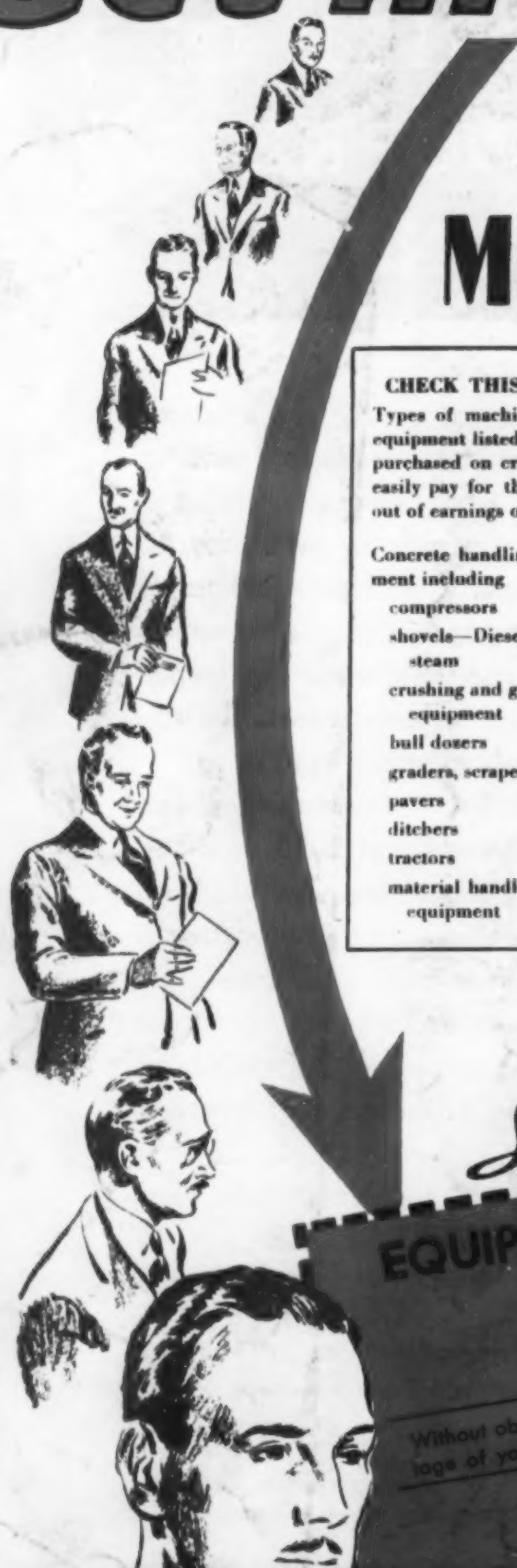
IN BUSINESS FOR YOUR SAFETY

District Offices: New York, Chicago, Philadelphia, Pittsburgh, Ft. Worth, Denver, San Francisco, Los Angeles, Birmingham, Tacoma

HAZARD WIRE ROPE

LAY·SET *Preformed* Wire Rope

✱ ALL HAZARD WIRE ROPES MADE OF IMPROVED PLOW STEEL ARE IDENTIFIED BY THE GREEN STRAND



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Types of machinery and equipment listed below, if purchased on credit, may easily pay for themselves out of earnings or savings.

Concrete handling equipment including
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- crushing and grinding equipment
- bull dozers
- graders, scrapers
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- ditchers
- tractors
- material handling equipment

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Equipment Acceptance is featuring a New 5% Financing Plan applicable to every standard type of machinery and plant equipment—whether purchased by owner or leaseholder. Modernization Credit thus becomes available to all, on identical terms.

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